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ABSTRACT

This volume is the second in a two-volume core curriculum designed for use in teaching a course in bricklaying. Covered in the first four units are hand tools, power tools, miscellaneous equipment, and builder's levels. The second section of the guide comprises units on the following building materials: mortars, masonry units, and anchors and reinforcements. Concluding the guide are four units of shop practices dealing with wall layout, techniques for spreading mortar and laying block and brick, chimneys and fireplaces, and related layout and construction. Each instructional unit contains some or all of the following: performance objectives, suggested activities, information sheets, transparency masters, assignment sheets, job sheets, tests, and answers to the test and assignment sheets. (MN)

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OKLAHOMA STATE BOARD OF VOCATIONAL AND TECHNICAL EDUCATION

# bricklaying curriculum: principles of bricklaying

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Vol II of 2

2

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# Bricklaying Curriculum

## Principles of Bricklaying

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and
**Oklahoma State Board of Vocational and Technical Education**
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# BRICKLAYING CURRICULUM
# PRINCIPLES OF BRICKLAYING

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# FOREWORD

In 1975 the Associated General Contractors of America met with representatives of the Oklahoma Curriculum and Instructional Materials Center to discuss the possibility of developing, as a cooperative project, a course of instruction designed for training bricklayers who will make their careers in industrial and commercial construction.

This publication is the result of that discussion. It is the product of close coordination among general contractors, bricklayers, and vocational/technical educators. This manual represents a conscious effort to meld the practical experience of those in the construction industry with the expertise of those in the field of vocational education.

The trainers of skilled construction workers are faced with the challenge of providing thorough and modern training to the backbone of the construction industry, its work force. The purpose of this manual is to assist bricklayer instructors in providing a high-caliber instructional program. In 1982 AGC and CIMC decided that there was a need to update this manual in order to keep up with the everchanging materials, skills, techniques, and demands of the profession. Therefore, we have revised this manual with these changes in mind. Although the format reflects a systematic approach to instructional materials development and the latest in educational technology innovations, the information in *Bricklaying Curriculum: Principles of Bricklaying* should be adapted and modified to coincide with local conditions. To make the training process complete, the materials should be coupled with the instructor's own methods and experience, and supplemented with additional materials.

Dr. Francis T. Tuttle, Director
Oklahoma State Department of
Vocational and Technical Education

Robert B. Fay, Chairman
Manpower and Training Committee
Associated General Contractors of America

# PREFACE

For many years contractors and those responsible for training bricklayers felt the need for instructional materials to be used in the training. In 1977 the Associated General Contractors of America, with the cooperation and support of the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, accepted the challenge to produce a manual for use in training bricklayers in those areas in which they are expected to be proficient.

Instructional material in this manual is written in terms of student performance, using measurable behavioral objectives. This is an innovative approach to teaching that accents and augments the teaching/learning process. Criterion-referenced evaluation instruments provide for a uniform measurement of student progress.

Bricklayer instructors are faced with the challenge of providing students with the skill and related information necessary to meet the demands of a changing profession. Competition for jobs is greater than ever. Therefore, the bricklayer must be better trained and better equipped to find and retain meaningful employment. This is why AGC and CIMC felt a need to revise and update this manual.

The purpose of this manual is to assist bricklayer instructors in providing instruction throughout the industry. This publication should be supplemented by each instructor's methods and materials. Any information in this manual that does not concur with the instructor's course of study can be modified to meet personal needs.

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We are grateful to the following individuals and companies for their technical support during the development of this manual.

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There is much work that goes into the making of a manual, and there are many people behind the scenes who make a publication possible. Special appreciation is extended to Dona Landreth, Gari Sha Robinson, Rose Primeaux, and Allison McLaughlin, staff members in the Word Processing Center, for making sure that the final typed copies are of the highest quality. The artwork in this book also deserves special commendation. Special thanks to artists Regina Beaney, Gary Bradley, Kim Hale, Kathryn Hansen, and Carrie Williams for their drawings.

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Laborn J. "Bud" Hendrix, AGC-CIMC Writer
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## USE OF THIS PUBLICATION

### Instructional Units

*Bricklaying Curriculum: Principles of Bricklaying* contains three sections and eleven instructional units. A standard format was established in 1970 for development of instructional materials for all Oklahoma vocational teachers. This format includes eight basic components that form a unit of instruction: performance objectives, suggested activities for the instructor, information sheets, assignment sheets, job sheets, transparency masters, tests, and answers to tests and assignment sheets. Depending on the specific objectives, there may or may not be transparency masters, assignment sheets, and job sheets included in the unit of instruction.

All of the unit components "zero in" on measurable and observable learning outcomes. Instructors are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the instructor will help him or her determine the following

A. Amount of material that can be covered in each class period
B. Skills that must be demonstrated
    1. Supplies and equipment needed
    2. Amount of practice needed
    3. Amount of class time needed for demonstrations
C. Supplementary materials, such as pamphlets and filmstrips, that must be ordered
D. Resource people who must be contacted

### Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching/learning process, it is important that instructors and students have a common understanding of the intent of the objectives. Following is a list of performance terms, their meanings, and behavioral synonyms that may have been used in this material.

A. Name — The individual supplies a name for objects, events, or people

Behavioral synonyms: Label, list, letter, record, reiterate, repeat, write

B. Identify — The individual selects a named, described, or pictured object by pointing to it, touching it, picking it up, or selecting it

Behavioral synonyms: Select, mark, match, choose, judge

C. State a rule — The individual communicates a relationship or principle that could be used to solve problems or perform a task

D. Apply a rule — The individual supplies an answer to a problem by using a stated relationship or principle

Behavioral synonyms: Solve, calculate

E. Describe — The individual relates sufficient characteristics or properties of an object or event so that a second individual will be able to state what is being discussed

Behavioral synonyms: Define, discuss, interpret, recite, tell how, tell what happens when

F. Distinguish — The individual selects an object or event from two or more that are easily confused

Behavioral synonyms: Discriminate, differentiate

G. Order — The individual arranges three or more objects or events in a sequence based on a stated property

Behavioral synonyms: Arrange, sequence, list in order, classify, divide, isolate, sort

H. Construct — The individual makes a physical object, a verbal statement, or a drawing

(NOTE: *Construct* is used when the finished product or result is important.)

Behavioral synonyms: Draw, make, build, design, formulate, reproduce, transcribe, convert, put together, compile

I. Demonstrate — The individual performs several operations necessary to carry out a specified process

(NOTE: *Demonstrate* is used when it is desirable to watch the student perform a task, one of the highest levels of student performance.)

Behavioral synonyms: Show your work, show procedure, perform an experiment, perform the steps, operate, remove, replace, turn off/on, (dis)assemble, (dis)connect

The objectives should be provided for students and stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught.

The objective sheet may also be used as a quick pretest to determine prior knowledge of students and to determine whether further study or activities are necessary. Instructors should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When changes in objectives are made, the instructor should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

**Suggested Activities** (pink pages)

This component is included only in instructor material. The suggested activities page assists instructor during the preparation stage of the teaching/learning process by providing suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audio-visual materials prepared, and outside resources contacted. Duties of the instructor will vary according to the particular unit.

The references that are listed are ones used in the development of each unit. They should be used by the instructor to supplement her or his knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

**Information Sheet** (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical outline form and is keyed to the specific objectives.

Instructors will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and instructors to add notes that supplement, localize, personalize, or provide motivation for each unit.

**Transparency Masters** (white pages in instructor material and green in student material)

Transparency masters provide information in a special way. Transparencies direct the class's attention to the topic of discussion. Transparencies may present new information, or they may reinforce information presented in the information sheet. They are particularly effective when identification is necessary. Make transparencies and place them in the notebook where they will be immediately available for use.

**Assignment Sheets** (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience with the information. They assist students in the application of knowledges that are necessary prerequisites to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided when appropriate and can be used by the student and/or instructor for checking student progress.

**Job Sheets** (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomoter skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

Instruments in job sheets are not in order of use. The order of use should be taught in the classroom. In this way, students will not depend entirely on job sheets for instrument setup.

Instructor should demonstrate to students the procedures outlined in each job sheet. Furthermore, the instructor needs to localize the job sheet according to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

**Tests** (yellow pages)

This component provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pencil and performance objectives must be evaluated.

The tests may be written or oral. It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test, 85 percent in most units, may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each individual question. The final unit grade should be obtained by using the paper/pencil score along with evaluations of student demonstrations of the desired skills.

**Answers to Test and Assignment Sheets** (pink pages)

These components are designed to assist the instructor in evaluation of student performances.

**Page Numbering**

Each publication from the Curriculum and Instructional Materials Center is assigned a specific abbreviation. For example, *Bricklaying Curriculum: Principles of Bricklaying* has been abbreviated PBL. The units are then numbered consecutively within each section. An example of a page number is PBL-1-A. Since CIMC publications are loose leaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

**Methods of Disseminating Material**

Material may be given out a unit or page at a time to keep the material before the student always new. Some instructors ask students to furnish a three-ring binder for the units. This is convenient for taking the materials home to study. Upon completion, each unit is then placed in a larger binder. The large binders may be purchased at cost from the CIMC. Some instructors store the materials by units in filing cabinets or boxes until needed. All the units may be given out at once if desired.

For best results, provide student materials for each student. Student materials contain everything but the test answers, answers to assignment sheets, and suggested activities. All tests are collated at the back of student material and should be removed and stored until needed. Students should be allowed to take their materials home at the end of the year.

**Teaching Methods**

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

**Competency Profiles**

Competency profiles are folders used to document student performance. The profile contains a list of the specific job competencies that should be achieved prior to leaving the training program.

## HAND TOOLS
## UNIT I

### UNIT OBJECTIVE

After completing this unit, the student should be able to match hand tools to their specifications and use the tools to perform various bricklaying jobs. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

### SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with hand tools to their correct definitions.

2. Distinguish between modular spacing rule and standard brick spacing rule.

3. Identify basic tools included in a bricklayer's beginner's tool kit.

4. Match types of hammers to their specific uses.

5. Match types of chisels to their specific uses.

6. Match types of squares to their specific uses.

7. Match types of jointers to their specific uses.

8. Match related tools and equipment to their specific uses.

9. Identify tools used in determining course alignment.

10. Match types of trowels to their specific uses.

11. Name factors to consider when selecting a brick trowel.

12. Identify and describe the correct way to hold a brick trowel.

13. State basic rules concerning care of the level.

14. State basic rules concerning care of hand tools.

15. State safety rules pertaining to hand tools.

## OBJECTIVE SHEET

16. Demonstrate the ability to

    a. Hold a brick trowel correctly.

    b. Measure, mark, and cut brick and block.

    c. Use a level.

    d. Use a framing square to lay out an 8-inch wall corner.

# HAND TOOLS
# UNIT I

## SUGGESTED ACTIVITIES

I. Suggested activities

   A. Obtain a complete set of tools to show students.

   B. Obtain transparencies.

      (NOTE: Transparencies are available from AGC and CIMC.)

   C. Provide students with objective sheet.

   D. Discuss unit and specific objectives.

   E. Provide students with information and job sheets.

   F. Discuss information sheet.

   G. Show students complete hand tool set; demonstrate the proper way to hold trowel.

   H. Demonstrate and discuss procedures outlined in job sheets.

   I. Give test.

   J. Complete appropriate section of competency profiles.

      (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM #1 — Spacing Rules
      2. TM #2 — Types of Hammers
      3. TM #3 — Types of Chisels
      4. TM #4 — Types of Squares
      5. TM #5 — Types of Jointers
      6. TM #6 — Related Tools and Equipment
      7. TM #7 — Related Tools and Equipment (Continued)

## SUGGESTED ACTIVITIES

        8. TM #8 — Types of Trowels

    E. Job sheets

        1. Job Sheet #1 — Hold a Brick Trowel Correctly

        2. Job Sheet #2 — Measure, Mark, and Cut Brick and Block

        3. Job Sheet #3 — Use a Level

        4. Job Sheet #4 — Use a Framing Square to Lay Out an 8-Inch Wall Corner

    F. Test

    G. Answers to test

III. Unit references

A. Kreh, Richard T., Sr. *Masonry Skills.* Albany, New York: Delmar Publishers, Inc., 1982.

B. *Tools and Equipment Catalog.* Gibsonia, Pennsylvania: Masonry Specialty Co., 1981.

C. Turcotte, Raymond J. *Bricklaying Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, Inc., 1977.

# HAND TOOLS
## UNIT I

## INFORMATION SHEET

I. Terms and definitions

A. Brick set — Type of chisel used to cut brick and block

B. Brick tongs — Tool designed for moving or carrying several bricks

C. Chalk box and line — Reel-type container holding chalk and line; line is pulled out and used to lay out and mark lines on floor for first course of brick or block

D. Corner pole — Adjustable rigid-type pole with line holder; used as a guide rather than building corners for a guide

E. Ferrule — Metal band around the handle of a trowel

F. Jointer — Tool used to smooth and shape mortar joints

G. Line block — Wood or plastic device used to keep mason's line tight

H. Line pin — Metal device used for securing mason's line at both ends of course height

I. Mortarboard or pan — Platform or pan used to hold mortar at a convenient location and height for use by bricklayer

J. Parge — To apply a thin coating of mortar or plaster to masonry

K. Rake — Metal device designed to rake out and shape mortar joints

L. Skewback — Sloping surface against which the end of an arch rests; may be brick cut on an angle

M. Story pole — Pole or rod upon which are indicated all of the masonry courses and openings, such as windows or doors, required in the job

N. Temper — To remix mortar to make it more workable

O. Trowel — Tool used to apply, spread, shape and smooth mortar when laying brick or block

## INFORMATION SHEET

II. Difference between modular spacing rule and standard brick spacing rule (Transparency #1)

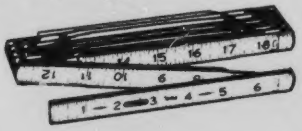
   A. Modular rule — Used for spacing course height of modular materials

   B. Brick spacing rule — Used for spacing nonmodular brick course height

III. Basic tools included in a bricklayer's beginner's tool kit (Figures 1-10)

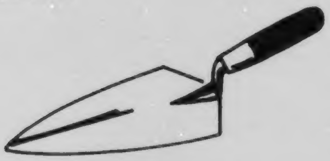
   A. Brick spacing rule

FIGURE 1



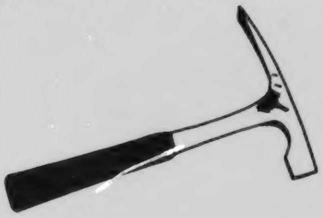
   B. Brick trowel

FIGURE 2



   C. Brick hammer

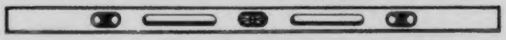
FIGURE 3



## INFORMATION SHEET

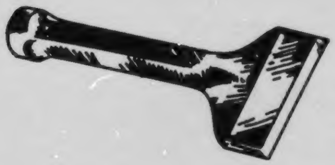
D. 48-inch level

FIGURE 4



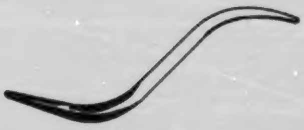
E. Brick set

FIGURE 5



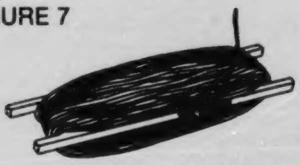
F. Concave jointer

FIGURE 6



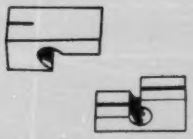
G. Mason's line

FIGURE 7



H. Corner blocks

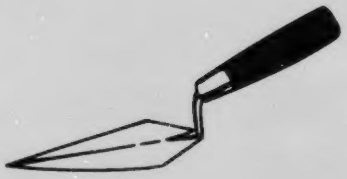
FIGURE 8



## INFORMATION SHEET

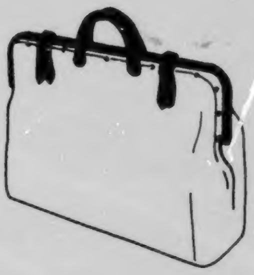
I. Pointing trowel

FIGURE 9



J. Tool bag

FIGURE 10



IV. Hammers and their uses (Transparency #2)

A. Brick hammer

1. Cutting bricks or blocks
2. Setting line pins
3. Cutting off fins or projections
4. Nailing wall ties

B. Tile hammer — Cutting tile

C. Mash — Striking brick set or other chisel

D. Bushhammer — Facing block or stone

E. Stonemason's hammer — Cutting or splitting stone

## INFORMATION SHEET

- V. Chisels and their uses (Transparency #3)
  - A. Brick set — Cutting brick or block
  - B. Mason's chisel — Cutting brick, block, and veined stone
  - C. Rubber-grip mason's chisel — Cushioning blow while cutting brick, block, or stone
  - D. Tooth chisel — Cutting soft stone
  - E. Pitching tool — Sizing, trimming, and facing hard stone; cutting heavy stone
  - F. Plugging chisel — Chipping mortar from joints
- VI. Squares and their uses (Transparency #4)
  - A. Steel framing
    - 1. Laying out corners
    - 2. Checking square of corner units
  - B. Combination
    - 1. Marking cuts of various angles
    - 2. Marking straight cuts
  - C. Bevel
    - 1. Marking cuts of various angles
    - 2. Marking skewbacks
- VII. Jointers and their uses (Transparency #5)
  - A. Concave jointer and sled-runner concave jointer
    - 1. Compressing joints
    - 2. Weatherproofing joints
    - 3. Giving concave appearance to joints
  - B. Flat jointer
    - 1. Compressing joints
    - 2. Shaping joints

## INFORMATION SHEET

C. V-jointer and sled-runner V-jointer

   1. Compressing joints

   2. Weatherproofing joints

   3. Giving a V design to joints

D. Tuck-pointer

   1. Compressing joints

   2. Shaping joints

   3. Pointing joints

E. Rake and skate-wheel rake

   1. Raking out joints and leaving a smooth or rough finish

   2. Creating attractive joint design

VIII. Uses of related tools and equipment (Transparencies #6 and #7)

A. Mortarboard and stand — Holding mortar at a convenient location and height for use by bricklayer

B. Brick tongs — Carrying and stacking bricks

C. Square-point shovel — Placing mortar on mortarboard, tempering mortar, and placing materials in mixer or mortar box

D. Brick and tile barrow — Moving bricks or blocks from stockpile to location where they will be used

E. Water bucket — Holding water for wetting mortarboard, tempering mortar, and cleaning tools

F. All-purpose brush — Brushing off walls and joints

G. Bolt cutter — Cutting reinforcement

H. Utility knife — Cutting fabric flashing; sharpening pencil

I. Wheelbarrow — Moving mortar from mixer or mortar box to work area

J. Mortar box — Mixing mortar

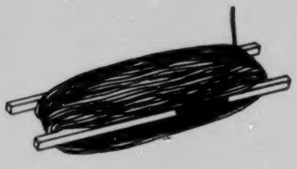
K. Rope and pulley — Pulling material from ground to height where it will be used

## INFORMATION SHEET

IX. Tools used in determining course alignment (Figures 11-21)

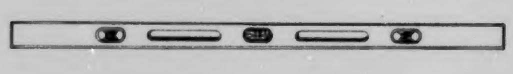
A. Mason's line

FIGURE 11



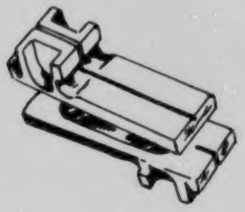
B. 48-inch level

FIGURE 12



C. Line blocks

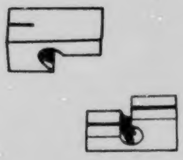
FIGURE 13



## INFORMATION SHEET

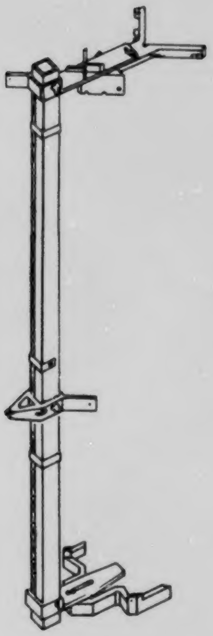
D. Corner blocks

FIGURE 14



E. Corner pole

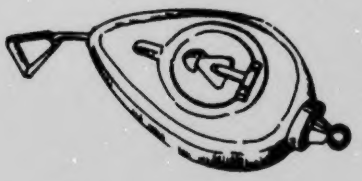
FIGURE 15



## INFORMATION SHEET

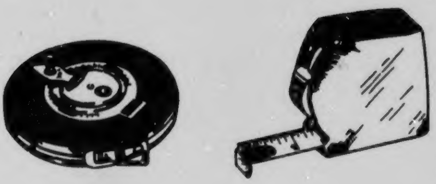
F. Chalk box and line

FIGURE 16



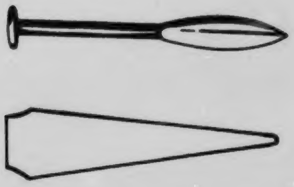
G. Steel tapes

FIGURE 17



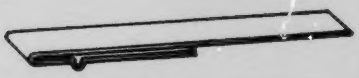
H. Line pins

FIGURE 18



I. Line twig

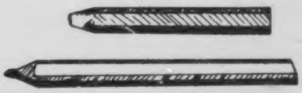
FIGURE 19



## INFORMATION SHEET

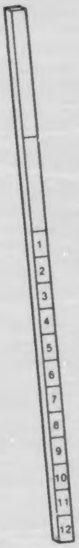
J. Marking crayon and pencil

FIGURE 20



K. Story pole

FIGURE 21



X. Types of trowels and their uses (Transparency #8)

A. Brick — Spreading mortar for laying brick, block, and stone

B. Pointing — Pointing, grouting, and mixing mortar

C. Caulking (tuck-pointer) — Pointing, caulking, and tooling mortar joints

D. Margin — Mixing mortar, grout, and waterproofing compounds in bucket

E. Plastering — Plastering or parging mortar or waterproofing onto wall; applying base coat for tile and veneer

## INFORMATION SHEET

XI. Factors to consider when selecting a brick trowel

A. Balance

B. Shape of blade

C. Weight

D. Size

E. Flexibility of blade

F. Quality of steel

G. Angle of blade in relation to handle

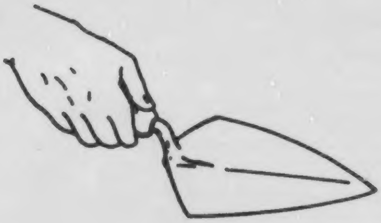
H. Type of handle

(NOTE: Trowels are made in a variety of sizes and shapes, with wood, plastic, or leather handles.)

XII. Correct way to hold a brick trowel (Figure 22)

(NOTE: The method of holding a trowel may vary slightly due to the size of a person's hand and the feel of the trowel in the hand.)

FIGURE 22



A. Grasp handle of trowel with fingers on underside of handle

B. Place thumb on top of ferrule, pointing toward tip of blade

C. Hold handle with a firm yet flexible grip

D. Apply pressure between thumb and forefinger

## INFORMATION SHEET

XIII. Basic rules concerning care of the level

- A. Do not tap level with other tools
- B. Protect wooden level by using linseed oil on it regularly
- C. Keep windows clean
- D. Do not use level as a pry bar
- E. Always position level so that it will not be knocked over
- F. Always store level in a safe place
- G. Check accuracy of level regularly

XIV. Basic rules concerning care of hand tools

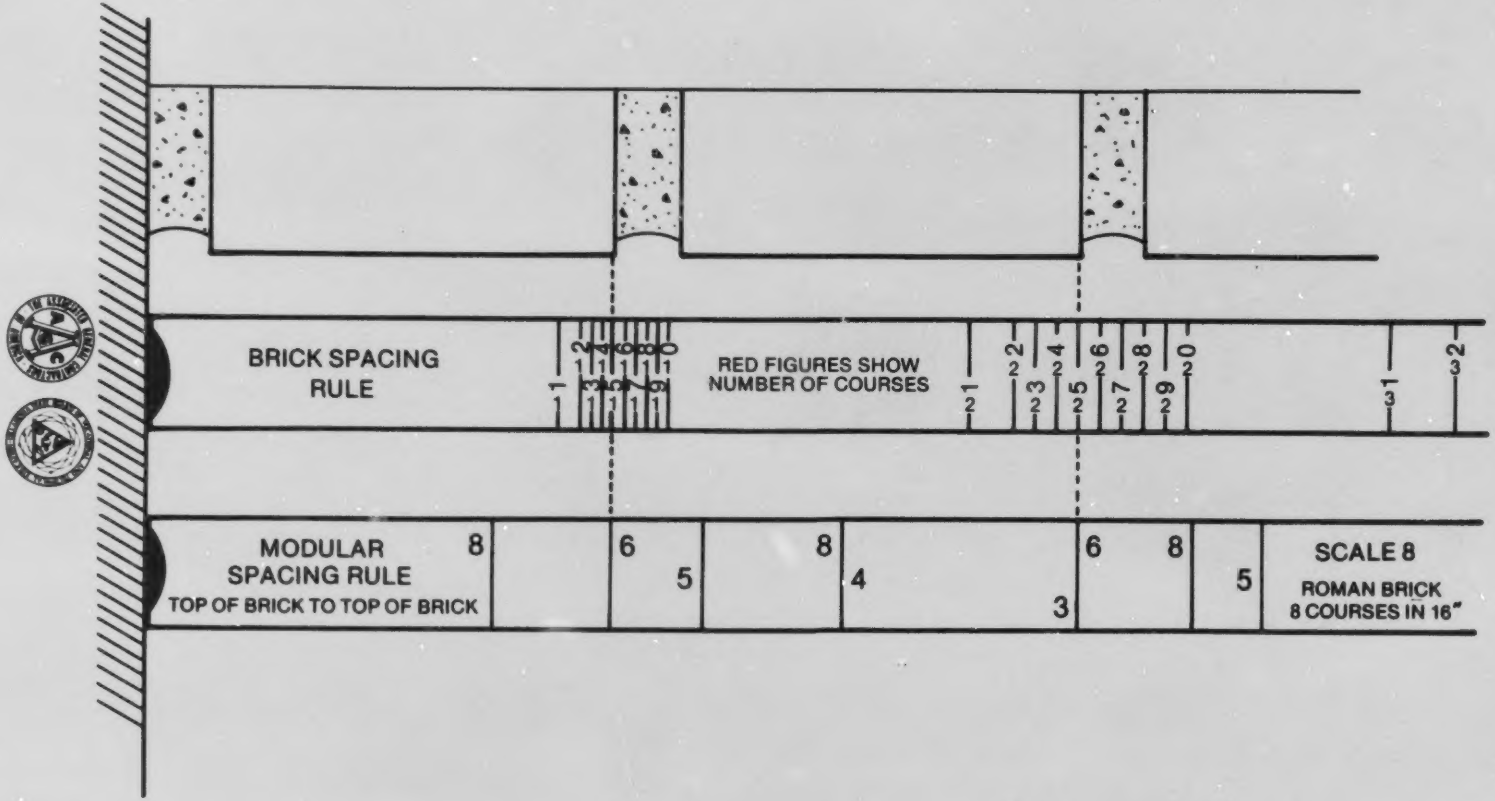
- A. Keep all tools clean
- B. Keep brick hammer sharp and square
- C. Keep folding rules oiled
- D. Keep chisel blade sharp and free of burrs
- E. Keep all tool handles tight

  (NOTE: Never leave wooden-handled tools submerged in water.)

XV. Safety rules pertaining to hand tools

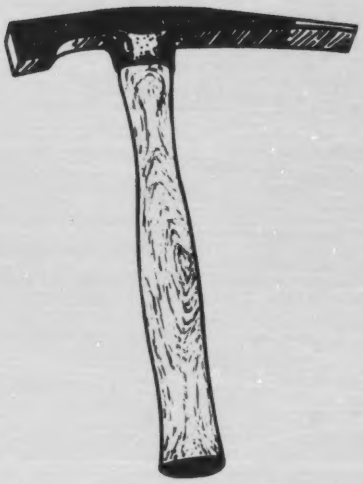
- A. Use the right tool for the job
- B. Do not use trowel for hammer
- C. Do not hammer on level
- D. Wear safety goggles when cutting or chipping
- E. Do not use broken or defective tools
- F. Do not cut reinforcement with brick hammer, chisel, or trowel
- G. Devote full attention to the task being performed

# Spacing Rules

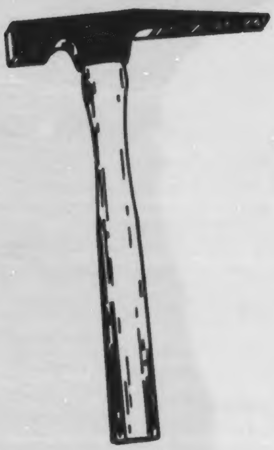

BRICK SPACING RULE
RED FIGURES SHOW NUMBER OF COURSES
MODULAR SPACING RULE
TOP OF BRICK TO TOP OF BRICK
8
6
5
8
4
3
6
8
5
SCALE 8
ROMAN BRICK
8 COURSES IN 16"

PBL - 19-A

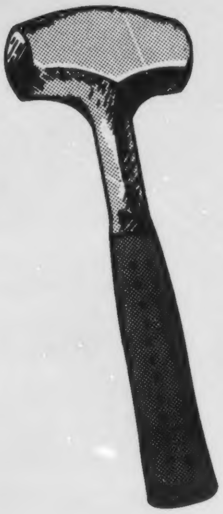
# Types of Hammers



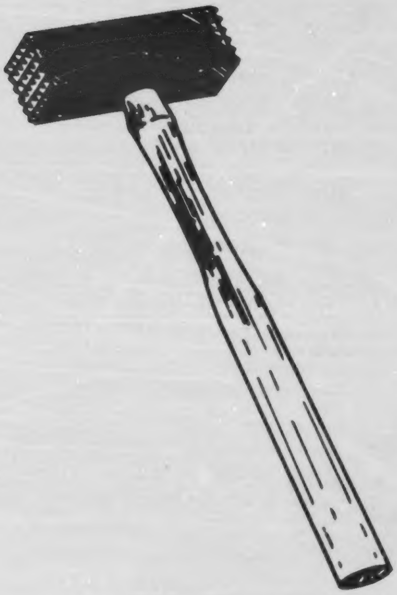
Brick Hammer



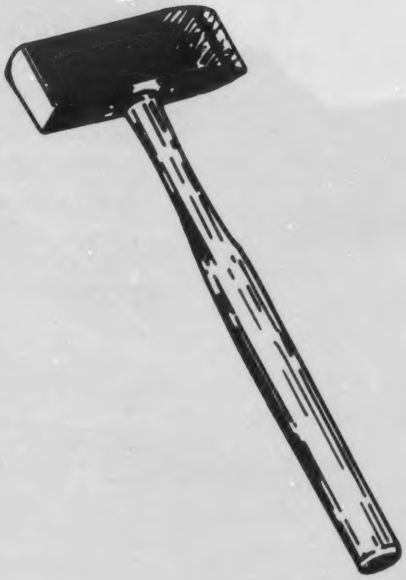
Tile Hammer



Mash

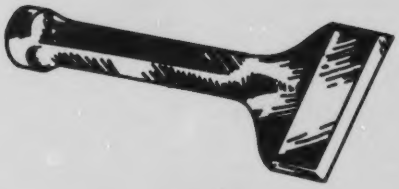


Bushhammer

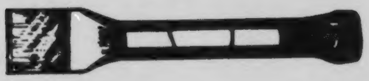


Stonemason's Hammer

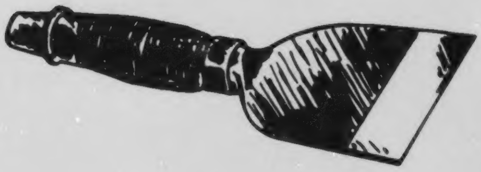
# Types of Chisels



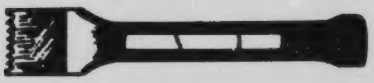
Brick Set



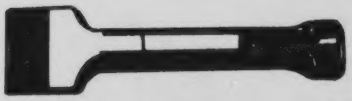
Mason's Chisel



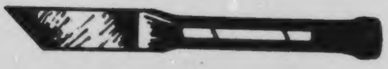
Rubber-Grip Mason's Chisel



Tooth Chisel

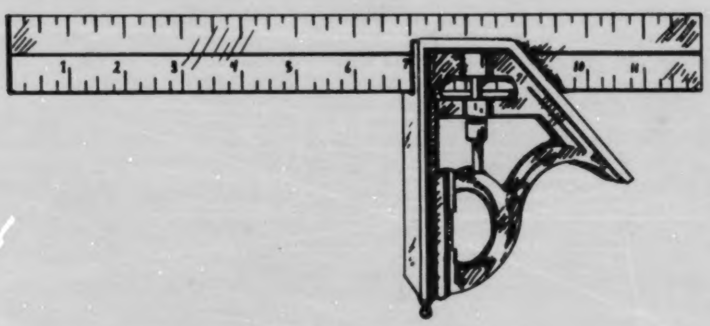


Pitching Tool

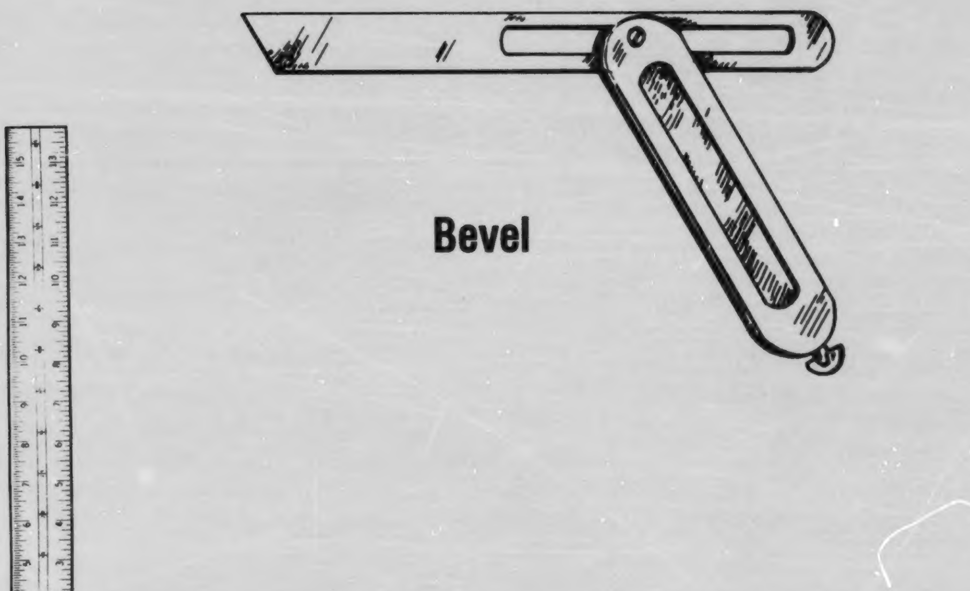


Plugging Chisel

# Types of Squares



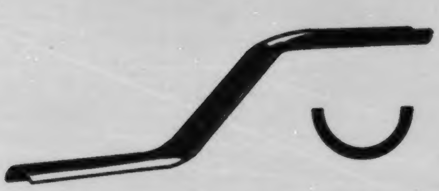
Combination



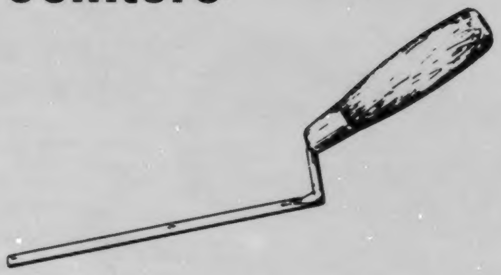
Bevel

Steel Framing

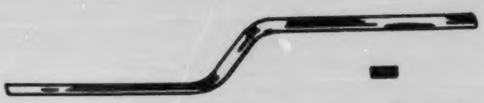
# Types of Jointers



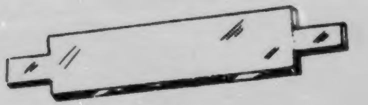
**Concave Jointer**



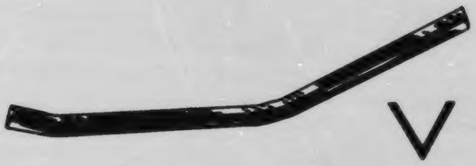
**Tuck-Pointer**



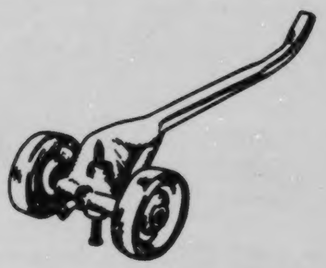
**Flat Jointer**



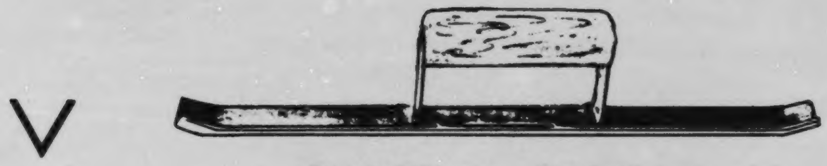
**Rake**



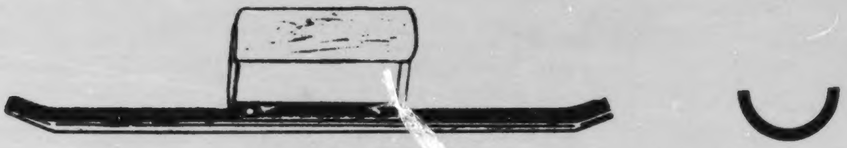
**V-Jointer**



**Skate-Wheel Rake**

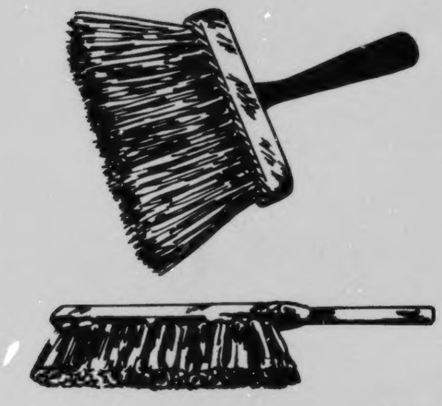


**Sled-Runner V-Jointer**

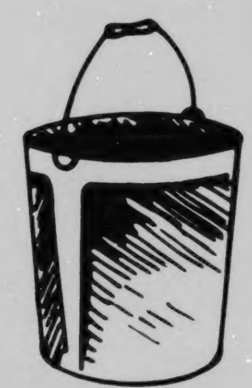


**Sled-Runner Concave Jointer**

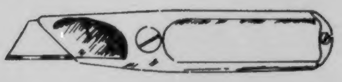
# Related Tools and Equipment



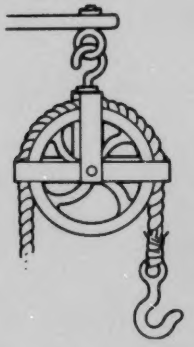
All-Purpose Brush



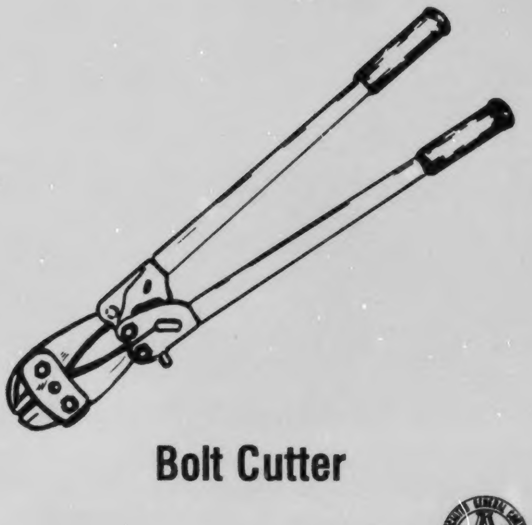
Water Bucket



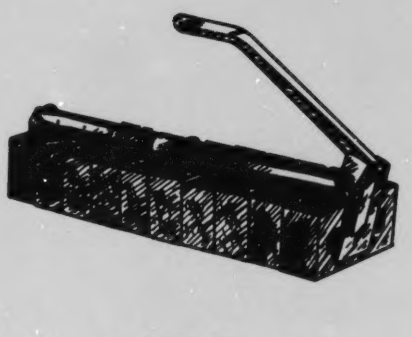
Utility Knife



Rope and Pulley



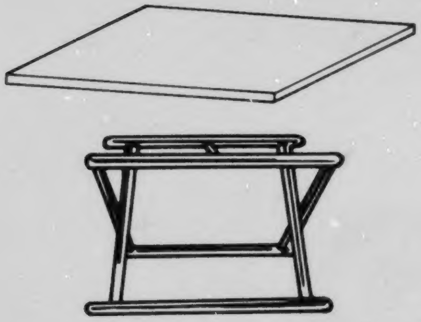
Bolt Cutter



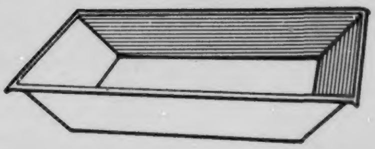
Brick Tongs

# Related Tools and Equipment

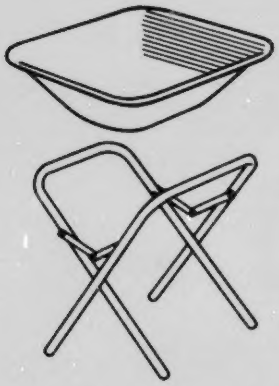
## (Continued)



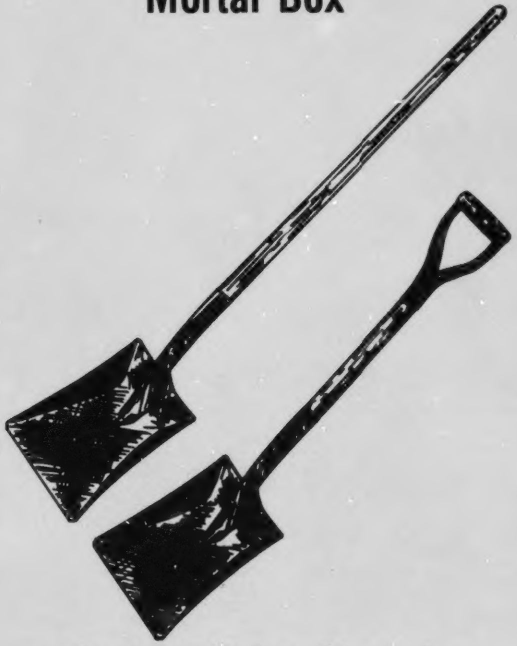
Mortarboard and Stand



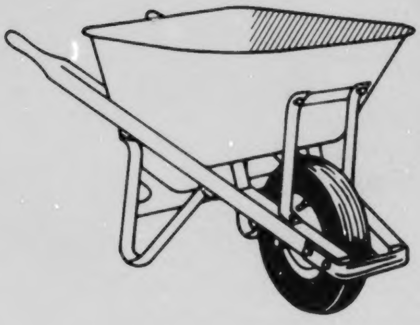
Mortar Box



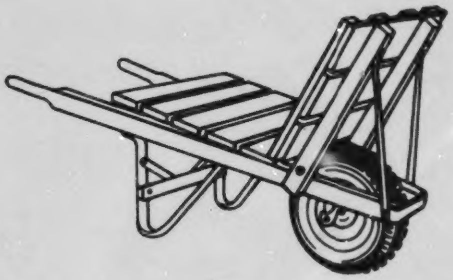
Mortar Pan and Stand



Square-Point Shovels

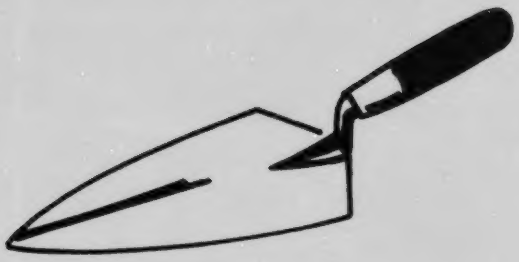


Wheelbarrow

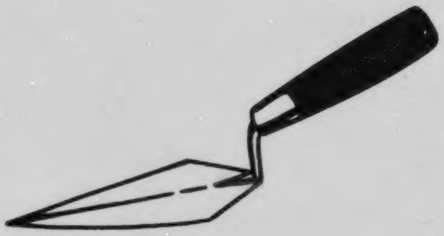


Brick and Tile Barrow

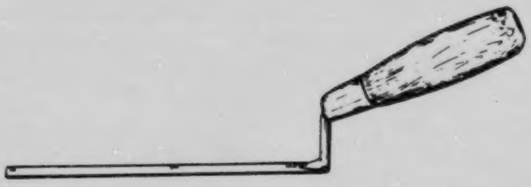
# Types of Trowels



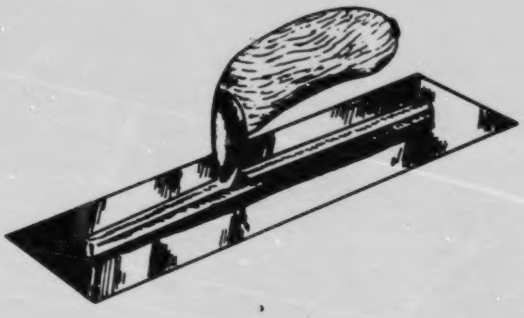
Brick



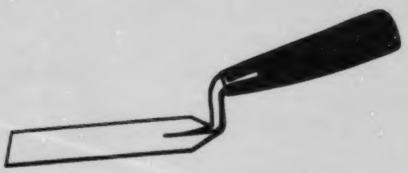
Pointing



Caulking (Tuck-Pointer)



Plastering



Margin

## HAND TOOLS
## UNIT I

### JOB SHEET #1 — HOLD A BRICK TROWEL CORRECTLY

I. Equipment — Brick trowel

II. Procedure

A. Grasp handle of brick trowel with fingers on underside of handle

B. Place thumb on top of ferrule, pointing toward tip of blade

C. Hold handle with a firm yet flexible grip

D. Apply pressure between thumb and forefinger

(NOTE: This is the proper way to hold the brick trowel. Continue practicing to hold the trowel until it feels natural. You may also want to practice picking up mortar.)

E. Put away equipment

# HAND TOOLS
# UNIT I

## JOB SHEET #2 — MEASURE, MARK, AND CUT BRICK AND BLOCK

I. Equipment and materials

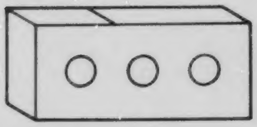
- A. Brick hammer
- B. Brick set
- C. Rule or tape
- D. Crayon or pencil
- E. Brick
- F. Block
- G. Safety goggles
- H. Combination square

(NOTE: Be sure to put on safety goggles before starting procedures.)

II. Procedure for cutting brick

- A. Mark face of brick where it is to be cut (Figure 23)

FIGURE 23



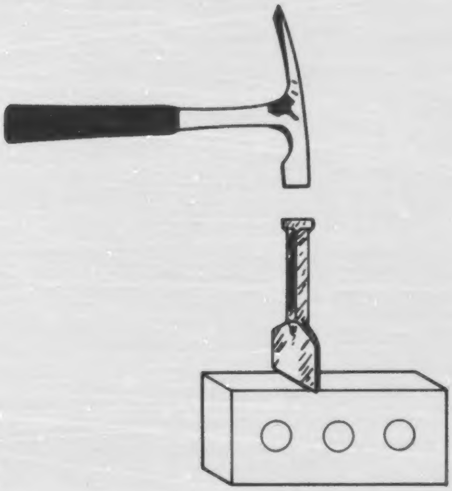
## JOB SHEET #2

B. Place brick on smooth, cushioned surface with marked face up

(NOTE: Never place brick on a hard surface for cutting.)

C. Place brick set on mark on brick; hold vertically with flat side of blade facing direction of finished cut (Figure 24)

FIGURE 24



D. With brick hammer, strike brick set a light blow, just enough to score brick

E. Turn brick to opposite side and repeat procedure

F. Continue turning and scoring until brick is scored on all four sides

(NOTE: Some bricks do not have to be scored on all four sides.)

G. Turn brick so that face is up

H. Place brick set vertically on scored mark; strike brick set sharply with hammer

(NOTE: The brick should break cleanly along the scored line.)

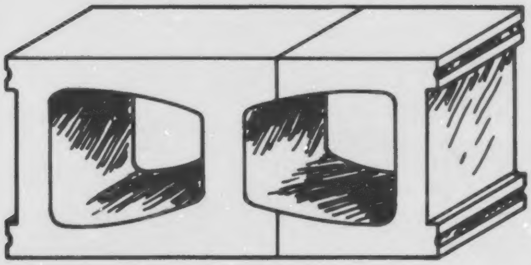
III. Procedure for cutting block

A. Mark face of block where it is to be cut

## JOB SHEET #2

B. Use square to transfer mark to other three sides of the block (Figure 25)

FIGURE 25

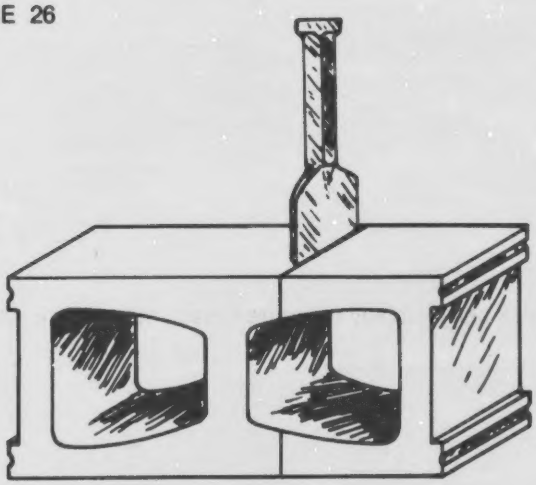


C. Place block on smooth, cushioned surface with face up

(NOTE: Never place block on a hard surface for cutting.)

D. Place brick set vertically on mark on block, with flat side of blade facing direction of finished cut (Figure 26)

FIGURE 26



## JOB SHEET #2

E. With brick hammer, strike brick set a light blow, just enough to score block

(NOTE: Do not strike brick set too hard before scoring all four sides of the block.)

F. Turn block completely over; use same procedure to score this side

G. Score sides of block using same procedure

H. Turn block again so that face is up

I. Position brick set on scored mark; hold chisel firmly, and strike brick set sharply with hammer

(NOTE: Block should break cleanly along scored line.)

J. Clean work area; clean and put away all tools and equipment

# HAND TOOLS
# UNIT I

## JOB SHEET #3 — USE A LEVEL

I. Equipment and materials

- A. Levels, various lengths
- B. Vertical and horizontal work surfaces
- C. Pencil
- D. Tape
- E. Straightedge

II. Procedure for leveling

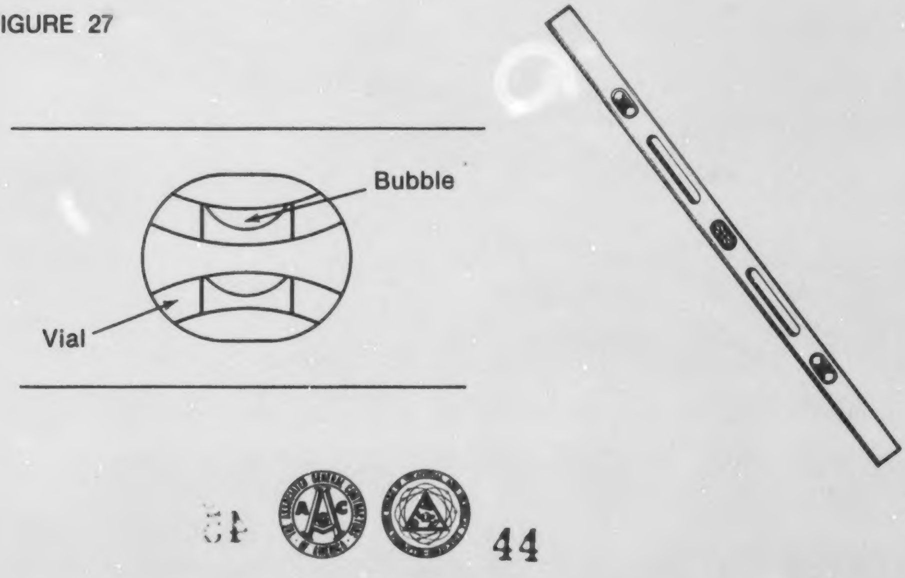
A. Check level for accuracy

(NOTE: Levels are very delicate instruments and must be handled carefully to ensure accuracy. Levels should be checked for accuracy before use, especially if the instrument has been dropped or jarred.)

1. Set base of level on flat, horizontal surface
2. Check bubble position in horizontal vial
3. Adjust surface or location of level until bubble is centered; mark position on surface

(NOTE: On a level surface, the bubble will lie evenly positioned between the lines on the vial. See Figure 27.)

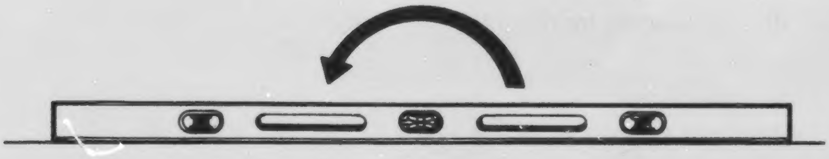
FIGURE 27



JOB SHEET #3

4. Rotate the level end-for-end and position it in the exact location as the bubble-centered reading (Figure 28)

FIGURE 28



5. Check bubble position in the horizontal vial

   (NOTE: The bubble will be centered from this side also if the level is accurate.)

6. Replace or repair level as necessary

B. Level a surface

1. Visually check surface for irregularities and foreign matter such as dirt

   (NOTE: Even small surface irregularities or particles can cause inaccurate readings in the level.)

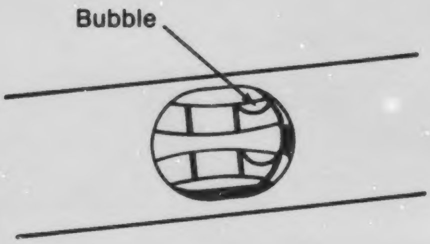
2. Clean or replace surface as necessary

3. Set base of level carefully and squarely on surface

4. Check bubble position

   (NOTE: The bubble will be displaced toward the high end of the level. See Figure 29)

FIGURE 29



## JOB SHEET #3

5. Adjust surface as necessary

6. Take additional readings to level surface as required

   (NOTE: Many factors affect the number of readings required. These include type of surface, material being used, and others.)

III. Procedure for plumbing

A. Check level for accuracy

1. Place base of level against flat, vertical surface (Figure 30)

2. Check bubble position in upper horizontal vial

3. Adjust surface or location of level until bubble is centered; mark position on surface

4. Rotate level end-for-end and position it in the exact location as that of the bubble-centered reading (Figure 31)

FIGURE 30

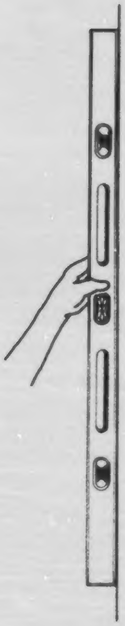
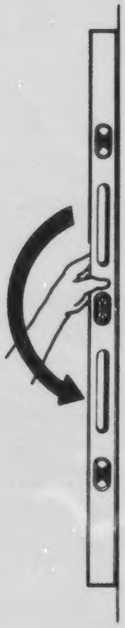


FIGURE 31



## JOB SHEET #3

5. Check bubble position in the upper horizontal vial

   (NOTE: The bubble will be centered at this end also if level is accurate.)

6. Replace or repair level as necessary

B. Plumb a surface

1. Visually check surface for irregularities and foreign matter such as dirt

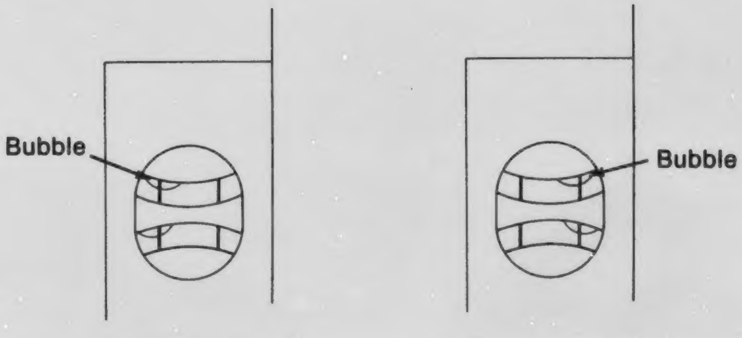
2. Clean or replace surface as necessary

3. Place base of level carefully and squarely against surface

4. Check bubble position in upper vial

   (NOTE: The bubble will move toward one end of the vial if the surface is not plumb. To plumb the surface, you must adjust it in the direction of bubble displacement. See Figure 32.)

FIGURE 32



Surface slants /

Surface slants \

5. Adjust surface as necessary

6. Take additional readings to plumb as required

C. Clean work area; put away tools and equipment

## HAND TOOLS
## UNIT I

## JOB SHEET #4 — USE A FRAMING SQUARE TO LAY OUT AN 8-INCH WALL CORNER

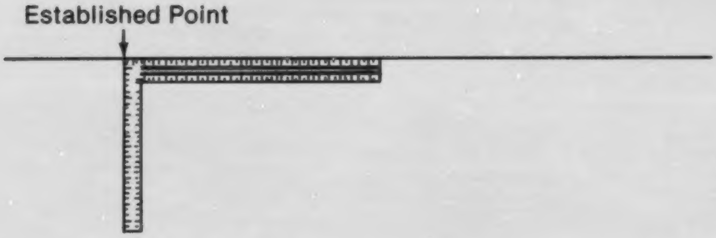
I. Equipment and materials

- A. Framing square
- B. Pencil
- C. Rule or tape

II. Procedure

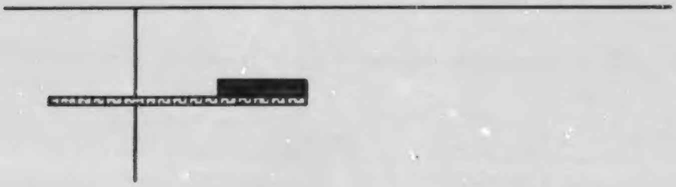
- A. Use framing square to square off of an established point on a line (Figure 33)

FIGURE 33



- B. Mark line along edge of square to establish a square corner
- C. Measure over 8 inches from this line, and make a small mark (Figure 34)

FIGURE 34



## JOB SHEET #4

D. Use square to square small mark with established line

E. Mark line along the edge of square

(NOTE: This establishes a square corner for an 8-inch wall.)

F. Recheck work

G. Put away tools and equipment

## HAND TOOLS
## UNIT I

## TEST

NAME ________________________________________ SCORE ________________

1. Match terms associated with hand tools to their correct definitions. Write the correct numbers in the blanks. Definitions are continued on the following page.

______a. To remix mortar to make it more workable

______b. Tool used to smooth and shape mortar joints

______c. Metal device used for securing mason's line at both ends of course height

______d. Type of chisel used to cut brick and block

______e. Wood or plastic device used to keep mason's line tight

______f. Tool used to apply, spread, shape, and smooth mortar when laying brick or block

______g. Metal device designed to rake out and shape mortar joints

______h. Pole or rod upon which are indicated all of the masonry courses and openings, such as windows and doors, required in the job

______i. Reel-type container holding chalk and line; line is pulled out and used to lay out and mark lines on floor for first course of brick or block

______j. Platform or pan used to hold mortar at a convenient location and height for use by bricklayer

______k. Adjustable rigid-type pole with line holder; used as a guide rather than building corners for a guide

______l. Tool designed for moving or carrying several bricks

1. Line block
2. Story pole
3. Skewback
4. Line pin
5. Chalk box and line
6. Trowel
7. Corner pole
8. Jointer
9. Brick tongs
10. Rake
11. Temper
12. Mortarboard or pan
13. Brick set
14. Parge
15. Ferrule

## TEST

______m. Sloping surface against which the end of an arch rests; may be brick cut on an angle

______n. Metal band around the handle of a trowel

______o. To apply a thin coating of mortar or plaster to masonry

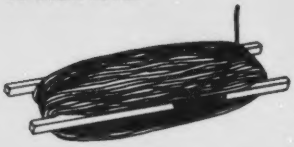
2. Distinguish between modular spacing rule and standard brick spacing rule. Write an "M" in the blank before modular spacing rule and a "B" in the blank before brick spacing rule.

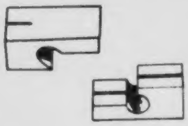
______a. Used for spacing course height of modular materials

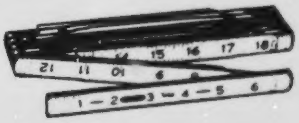
______b. Used for spacing nonmodular brick course height

3. Identify basic tools included in a bricklayer's beginner's tool kit. Write the correct names in the blanks.

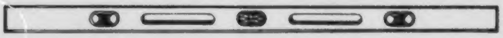
**Brick spacing rule**
**Concave jointer**
**Brick trowel**
**Brick hammer**
**48-inch level**
**Brick set**
**Mason's line**
**Tool bag**
**Corner blocks**
**Pointing trowel**

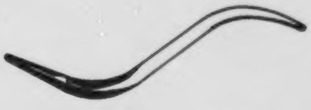




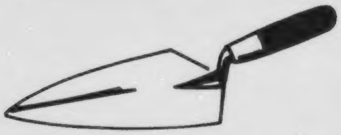


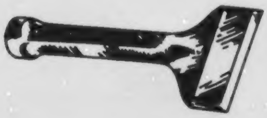
a. ____________________ b. ____________________ c. ____________________

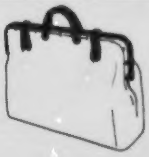




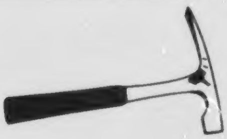
d. ______________________________ e. ______________________________

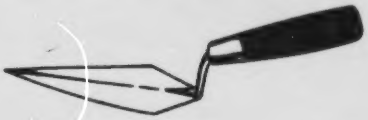






f. ____________________ g. ____________________ h. ____________________





i. ______________________________ j. ______________________________

## TEST

4. Match types of hammers to their specific uses. Write the correct numbers in the blanks. Answers may be used more than once.

______a. Setting line pins

______b. Facing block or stone

______c. Cutting tile

______d. Nailing wall ties

______e. Cutting or splitting stone

______f. Cutting bricks or blocks

______g. Striking brick set or other chisel

______h. Cutting off fins or projections

1. Brick hammer
2. Mash
3. Stonemason's hammer
4. Tile hammer
5. Bushhammer

5. Match types of chisels to their specific uses. Write the correct numbers in the blanks.

______a. Chipping mortar from joints

______b. Cutting soft stone

______c. Cutting brick or block

______d. Sizing, trimming, and facing hard stone; cutting heavy stone

______e. Cutting brick, block, and veined stone

______f. Cushioning blow while cutting brick, block, or stone

1. Brick set
2. Mason's chisel
3. Tooth chisel
4. Plugging chisel
5. Rubber-grip mason's chisel
6. Pitching tool

6. Match types of squares to their specific uses. Write the correct numbers in the blanks. Answers may be used more than once.

______a. Laying out corners

______b. Marking straight cuts

______c. Marking skewbacks

______d. Marking cuts of various angles

______e. Checking square of corner units

1. Bevel
2. Steel framing
3. Combination

## TEST

7. Match types of jointers to their specific uses. Write the correct numbers in the blanks. Some blanks may contain more than one answer.

______a. Compressing joints

______b. Creating attractive joint design

______c. Weatherproofing joints

______d. Pointing joints

______e. Raking out joints and leaving a smooth or rough finish

______f. Shaping joints

______g. Giving concave appearance to joints

______h. Giving a V design to joints

1. Tuck-pointer
2. Concave jointer and sled-runner concave jointer
3. Rake and skate-wheel rake
4. Flat jointer
5. V-jointer and sled-runner V-jointer

8. Match related tools and equipment to their specific uses. Write the correct numbers in the blanks.

______a. Placing mortar on mortarboard, tempering mortar, and placing materials in mixer or mortar box

______b. Cutting fabric flashing; sharpening pencil

______c. Carrying and stacking bricks

______d. Brushing off walls and joints

______e. Moving mortar from mixer or mortar box to work area

______f. Holding mortar at a convenient location and height for use by bricklayer

______g. Cutting reinforcement

______h. Moving bricks or blocks from stockpile to location where they will be used

______i. Holding water for wetting mortarboard, tempering mortar, and cleaning tools

______j. Pulling material from ground to height where it will be used

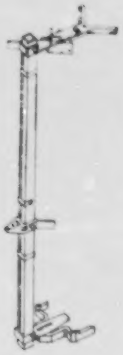
______k. Mixing mortar

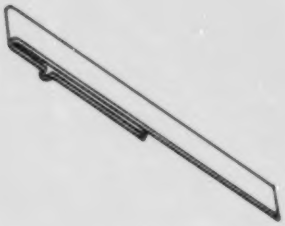
1. All-purpose brush
2. Water bucket
3. Mortarboard and stand
4. Utility knife
5. Brick and tile barrow
6. Wheelbarrow
7. Square-point shovel
8. Bolt cutter
9. Brick tongs
10. Mortar box
11. Rope and pulley

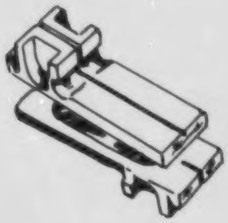
## TEST

9. Identify tools used in determining course alignment. Write the correct names in the blanks.

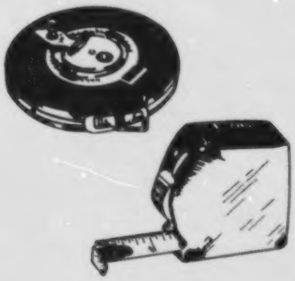
**Line twig**
**Steel tapes**
**Corner pole**
**Story pole**
**Line blocks**
**Corner blocks**
**Marking crayon and pencil**
**Mason's line**
**48-inch level**
**Line pins**
**Chalk box and line**

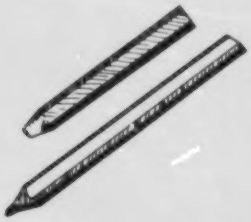


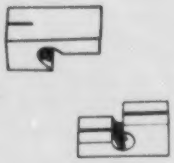




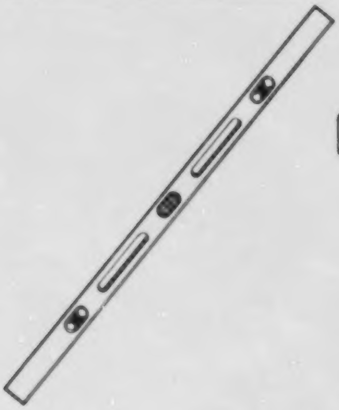
a. ______________________ b. ______________________ c. ______________________

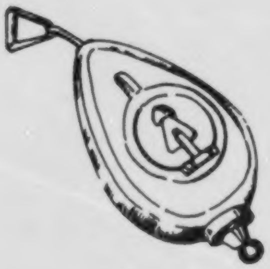


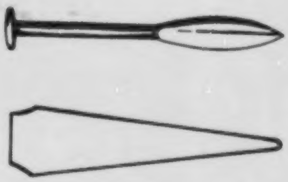




d. ______________________ e. ______________________ f. ______________________

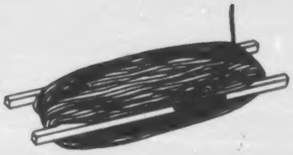


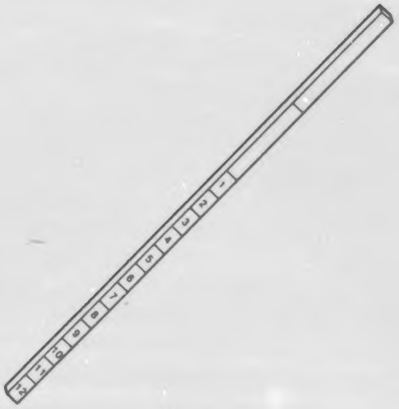




g. ______________________ h. ______________________ i. ______________________

## TEST





j. ______________________ k. ______________________

10. Match types of trowels to their specific uses. Write the correct numbers in the blanks.

_____a. Pointing, grouting, and mixing mortar

_____b. Pointing, caulking, and tooling mortar joints

_____c. Spreading mortar for laying brick, block, and stone

_____d. Plastering or parging mortar or waterproofing onto wall; applying base coat for tile and veneer

_____e. Mixing mortar, grout, and waterproofing compounds in bucket

1. Brick
2. Pointing
3. Caulking (tuck-pointer)
4. Margin
5. Plastering

11. Name five factors to consider when selecting a brick trowel.

a. ______________________________________

b. ______________________________________

c. ______________________________________

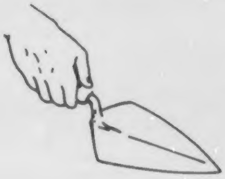
d. ______________________________________

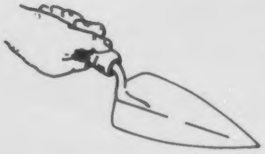
e. ______________________________________

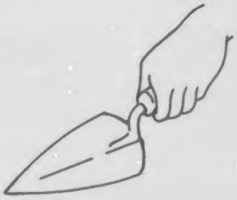
## TEST

12. Identify and describe the correct way to hold a brick trowel. Write an "X" in the blank below the correct illustration.

a. Identify







1) ____________ 2) ____________ 3) ____________

b. Describe

1) ____________________________

2) ____________________________

3) ____________________________

4) ____________________________

13. State four basic rules concerning care of the level.

a. ____________________________

b. ____________________________

c. ____________________________

d. ____________________________

14. State three basic rules concerning care of hand tools.

a. ____________________________

b. ____________________________

c. ____________________________

## TEST

15. State five safety rules pertaining to hand tools.

a. ________________________________________

b. ________________________________________

c. ________________________________________

d. ________________________________________

e. ________________________________________

(NOTE: Test question 16 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

16. Demonstrate the ability to

a. Hold a brick trowel correctly.

b. Measure, mark, and cut brick and block.

c. Use a level.

d. Use a framing square to lay out an 8-inch wall corner.

## HAND TOOLS
## UNIT I

### ANSWERS TO TEST

1.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | 11 | e. | 1 | i. | 5 | m. | 3 |
| b. | 8 | f. | 6 | j. | 12 | n. | 15 |
| c. | 4 | g. | 10 | k. | 7 | o. | 14 |
| d. | 13 | h. | 2 | l. | 9 | | |

2.

| | |
|---|---|
| a. | M |
| b. | B |

3.

| | | | |
|---|---|---|---|
| a. | Mason's line | f. | Brick trowel |
| b. | Corner blocks | g. | Brick set |
| c. | Brick spacing rule | h. | Tool bag |
| d. | Level | i. | Brick hammer |
| e. | Concave jointer | j. | Pointing trowel |

4.

| | | | |
|---|---|---|---|
| a. | 1 | e. | 3 |
| b. | 5 | f. | 1 |
| c. | 4 | g. | 2 |
| d. | 1 | h. | 1 |

5.

| | | | |
|---|---|---|---|
| a. | 4 | d. | 6 |
| b. | 3 | e. | 2 |
| c. | 1 | f. | 5 |

## ANSWERS TO TEST

6. a. 2
   b. 3
   c. 1
   d. 1, 3
   e. 2

7. a. 1, 2, 4, 5
   b. 3
   c. 2, 5
   d. 1
   e. 3
   f. 1, 4
   g. 2
   h. 5

8. a. 7
   b. 4
   c. 9
   d. 1
   e. 6
   f. 3
   g. 8
   h. 5
   i. 2
   j. 11
   k. 10

9. a. Corner pole
   b. Line twig
   c. Line blocks
   d. Steel tapes
   e. Marking crayon and pencil
   f. Corner blocks
   g. 48-inch level
   h. Chalk box and line
   i. Line pins
   j. Mason's line
   k. Story pole

10. a. 2
    b. 3
    c. 1
    d. 5
    e. 4

## ANSWERS TO TEST

11. Answer should include any five of the following
    - a. Balance
    - b. Shape of blade
    - c. Weight
    - d. Size
    - e. Flexibility of blade
    - f. Quality of steel
    - g. Angle of blade in relation to handle
    - h. Type of handle

12. a. 1
    - b. Description should include the following
        - 1) Grasp handle of trowel with the fingers on underside of handle
        - 2) Place thumb on top of ferrule, pointing toward tip of blade
        - 3) Hold handle with a firm yet flexible grip
        - 4) Apply pressure between thumb and forefinger

13. Answer should include any four of the following
    - a. Do not tap level with other tools
    - b. Protect wooden level by using linseed oil on it regularly
    - c. Keep windows clean
    - d. Do not use level as a pry bar
    - e. Always position level so that it will not be knocked over
    - f. Always store level in a safe place
    - g. Check accuracy of level regularly

## ANSWERS TO TEST

14. Answer should include any three of the following
    a. Keep all tools clean
    b. Keep brick hammer sharp and square
    c. Keep folding rules oiled
    d. Keep chisel blade sharp and free of burrs
    e. Keep all tool handles tight

15. Answer should include any five of the following
    a. Use the right tool for the job
    b. Do not use trowel for hammer
    c. Do not hammer on level
    d. Wear safety goggles when cutting or chipping
    e. Do not use broken or defective tools
    f. Do not cut reinforcement with brick hammer, chisel, or trowel
    g. Devote full attention to the task being performed

16. Performance skills evaluated to the satisfaction of the instructor

PBL - 57-A

# POWER TOOLS
## UNIT II

## UNIT OBJECTIVE

After completing this unit, the student should be able to identify different types of power tools used by bricklayers and be able to use a masonry saw. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with power tools to their correct definitions.
2. Identify power tools used by the bricklayer.
3. Match power tools to their specific uses.
4. Label the parts of the masonry saw.
5. Name types of cutting blades used on masonry saws.
6. List factors to consider when caring for the masonry saw.
7. State safety rules pertaining to the use of the masonry saw.
8. Demonstrate the ability to
    a. Dry cut masonry unit, using masonry saw with abrasive blade.
    b. Wet cut masonry unit, using masonry saw with diamond blade.

# POWER TOOLS
# UNIT II

## SUGGESTED ACTIVITIES

I. Suggested activities

   A. Gather materials and equipment for job sheet demonstrations.

      (NOTE: For Job Sheet #1, you may want to substitute the abrasive blade with the new diamond blade designed for dry cutting.)

   B. Obtain transparencies.

      (NOTE: Transparencies are available from AGC and CIMC.)

   C. Provide students with objective sheet.

   D. Discuss unit and specific objectives.

   E. Provide students with information and job sheets.

   F. Discuss information sheet.

   G. Emphasize the importance of safety rules.

   H. Demonstrate and discuss procedures outlined in job sheets.

   I. Give test.

   J. Complete appropriate section of competency profiles.

      (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM #1 — Power Tools Used by the Bricklayer

      2. TM #2 — Power Tools Used by the Bricklayer (Continued)

      3. TM #3 — Types of Cutting Blades Used on Masonry Saws

SUGGESTED ACTIVITIES

E. Job sheets

1. Job Sheet #1 — Dry Cut Masonry Unit, Using Masonry Saw with Abrasive Blade

2. Job Sheet #2 — Wet Cut Masonry Unit, Using Masonry Saw with Diamond Blade

F. Test

G. Answers to test

III. Unit references

A. *Tools and Equipment Catalog.* Gibsonia, Pennsylvania: Masonry Specialty Company, 1981.

B. Turcotte, Raymond J. *Bricklaying Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1977.

## POWER TOOLS
## UNIT II

## INFORMATION SHEET

I. Terms and definitions

   A. Bind — To restrict movement

   B. Fracture — To damage or destroy by breaking or cracking

   C. Masonry saw — Power-driven saw used for cutting masonry units

   D. Mortar mixer — Machine used for mixing mortar

   E. Raggle — Groove in masonry unit into which a metal flashing is fitted; groove made to receive adjoining material

   F. Step cutting — Passing material beneath blade with rapid, full-length strokes at approximately fifty to sixty strokes per minute

   G. Tuck-pointing — Replacing old mortar in joints or patching joints with new mortar

   H. Water curtain — Rubberized material that hangs on masonry saw just behind blade to keep blade from throwing water onto motor

II. Power tools used by the bricklayer (Transparencies #1 and #2)

   A. Masonry saw

   B. Portable masonry saw

   C. Tuck-pointer grinder

   D. Mortar mixer

   E. Hammer drill

   F. Air hammer

   G. Dry-wall screwdriver

   H. Pneumatic caulking gun

   I. Pressure cleaner

## INFORMATION SHEET

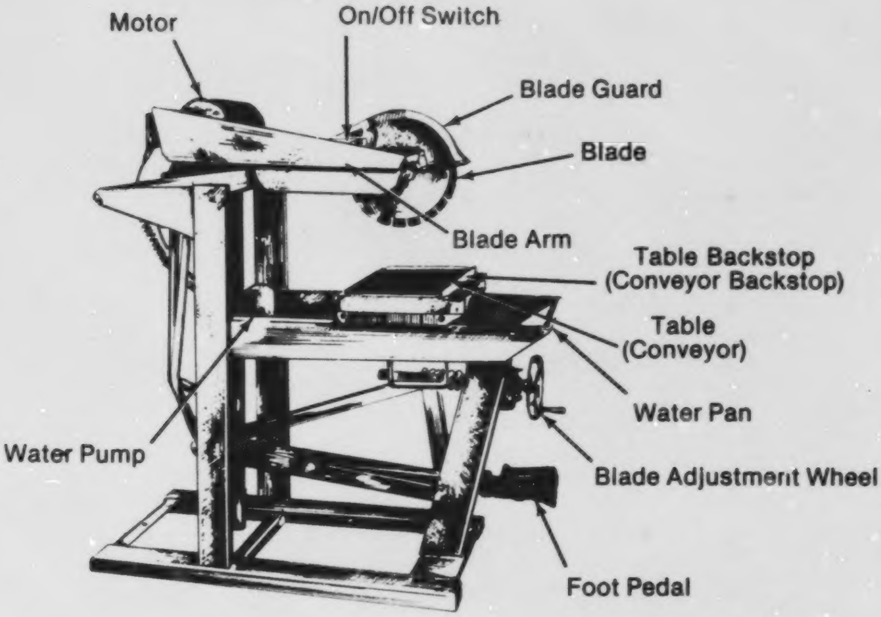
III. Power tools and their specific uses

- A. Masonry saw — Cutting masonry units
- B. Tuck-pointer grinder
    - 1. Removing mortar joints
    - 2. Cutting raggle
- C. Mortar mixer — Mixing mortar
- D. Hammer drill
    - 1. Drilling holes
    - 2. Chipping
- E. Air hammer
    - 1. Chipping
    - 2. Cutting holes
- F. Dry-wall screwdriver — Attaching anchors and ties
- G. Pneumatic caulking gun — Applying caulking
- H. Pressure cleaner
    - 1. Washing masonry
    - 2. Cleaning equipment

## INFORMATION SHEET

IV. Parts of the masonry saw (Figure 1)

FIGURE 1


Motor
On/Off Switch
Blade Guard
Blade
Blade Arm
Table Backstop (Conveyor Backstop)
Table (Conveyor)
Water Pan
Blade Adjustment Wheel
Foot Pedal
Water Pump

V. Types of cutting blades used on masonry saws (Transparency #3)

(NOTE: There are fast-cutting, standard, and long-life styles of each type of cutting blade. See manufacturer's recommendations for the proper blade style for various cutting procedures. The type and style of blade used will depend on the hardness of the material being cut.)

A. Diamond blade for wet cutting

B. Abrasive blade for dry cutting

C. Combination blades for wet or dry cutting

## INFORMATION SHEET

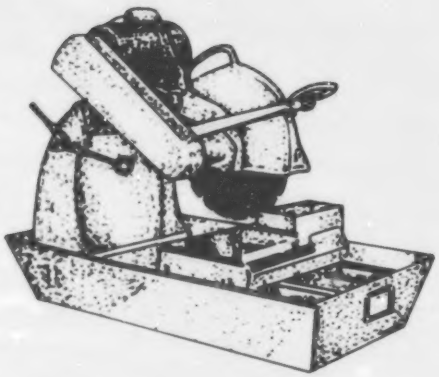
VI. Factors to consider when caring for the masonry saw

- A. Keep dust removed from saw
- B. Keep table clean and free of debris
- C. Keep parts lubricated
- D. Keep water pan free of debris
- E. Clean water pan and pump daily
- F. Check table wheels and wheel adjustment weekly

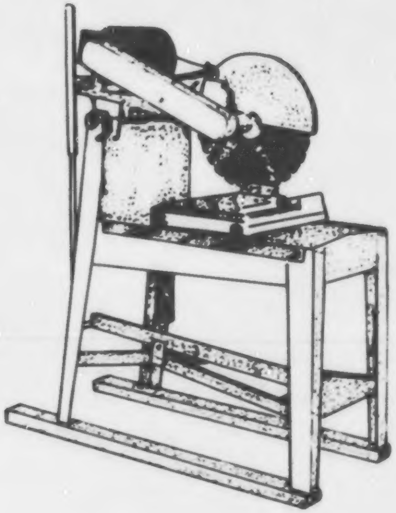
VII. Safety rules pertaining to the use of the masonry saw

- A. Wear goggles, gloves, and respirator or dust mask when dry cutting
- B. Wear goggles, rubber gloves, and rubber apron when wet cutting
- C. Keep hands away from blade
- D. Keep work area clean
- E. Inspect blade for damage before installing
- F. Clean and inspect blade-shaft collars and arbors before installing blade
- G. Tighten nut on blade shaft just enough to hold blade securely; do not over-tighten
- H. Operate blade within specified maximum operating speed
- I. Stand to outside of blade path when starting saw
- J. Hold materials securely when making cuts

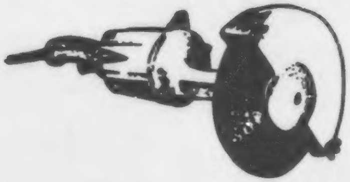
# Power Tools Used by the Bricklayer



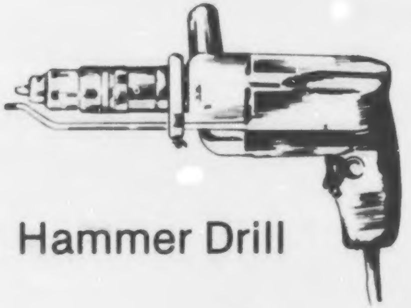
Portable Masonry Saw



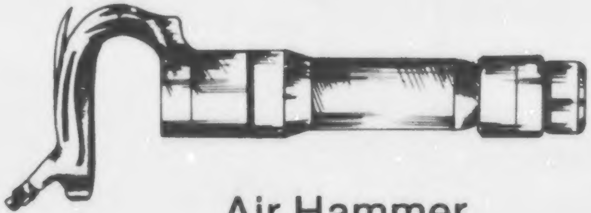
Masonry Saw



Tuck-Pointer Grinder



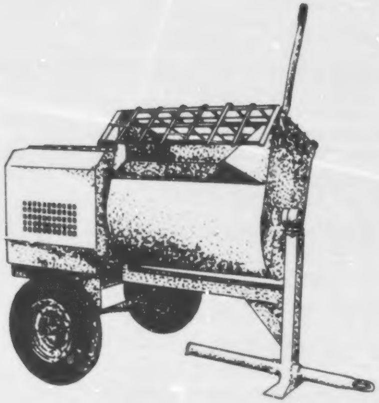
Hammer Drill



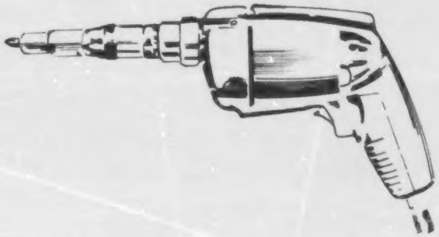
Air Hammer

# Power Tools Used by the Bricklayer

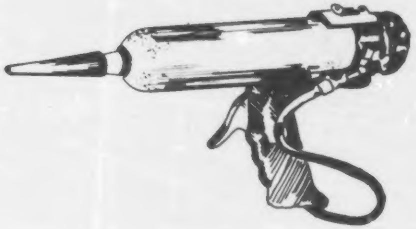
(Continued)



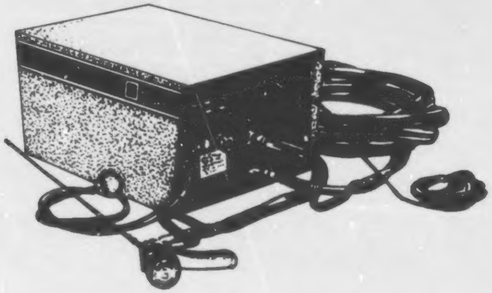
Mortar Mixer



Dry-Wall Screwdriver

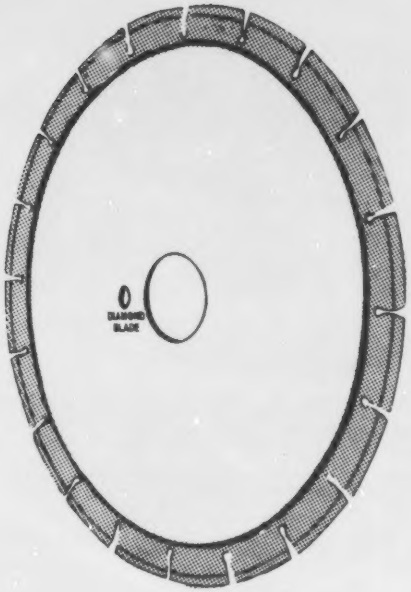


Pneumatic Caulking Gun

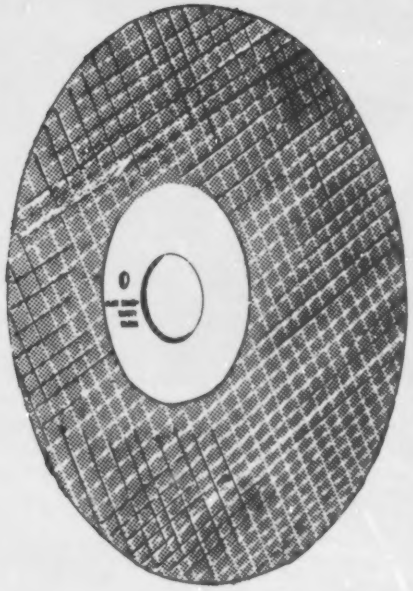


Pressure Cleaner

# Types of Cutting Blades Used on Masonry Saws



Diamond Blade for Wet Cutting



Abrasive Blade for Dry Cutting

(NOTE: There are combination abrasive and diamond blades on the market; both blades resemble those illustrated.)

# POWER TOOLS
# UNIT II

## JOB SHEET #1 — DRY CUT MASONRY UNIT, USING MASONRY SAW WITH ABRASIVE BLADE

I. Equipment and materials

   A. Masonry saw

   B. Abrasive blade for dry cutting

   (NOTE: A new type of diamond blade is available for dry cutting.)

   C. Safety goggles

   D. Gloves

   E. Concrete block

   F. Respirator or dust mask

II. Procedure for step cutting

   A. Clean blade-shaft collars and arbors

   B. Select proper blade

   C. Mount blade on shaft

   D. Tighten blade

   **(CAUTION: When tightening nut against blade-shaft collar, be sure to tighten enough to hold blade firmly, but *do not overtighten*. Excessive tightening can cause abrasive blade to fracture.)**

   E. Rotate blade to see that it is properly aligned

   F. Disconnect water pump; remove water curtain

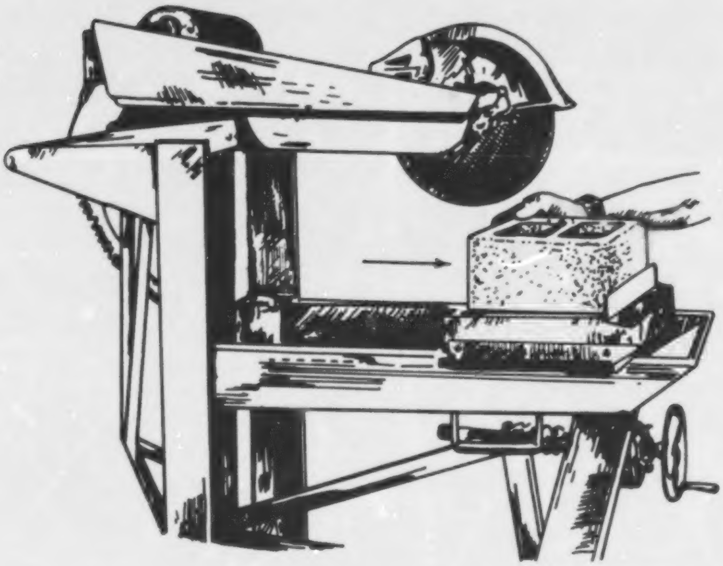
   G. Put on safety and protective clothing and equipment

## JOB SHEET #1

H. Place concrete block on table and secure firmly against backstop (Figure 2)

**(CAUTION: Be sure that block does not slip or rock during cutting operation. Slippage will bind blade and cause excessive wear and fracture.)**

FIGURE 2

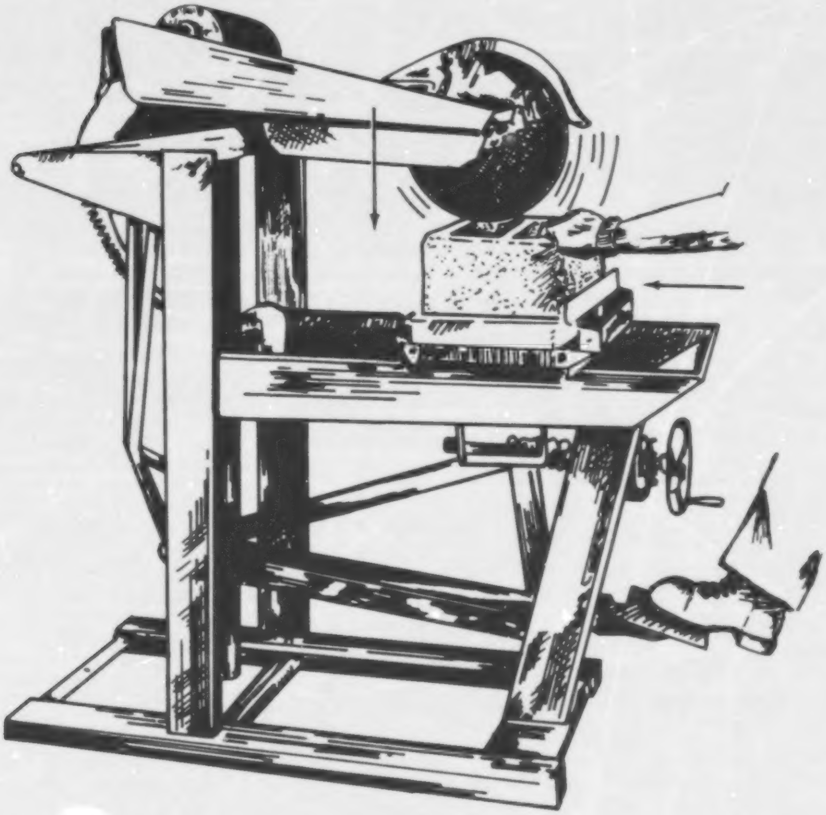


I. Move table forward until concrete block is near blade

## JOB SHEET #1

J. Push down on foot pedal until blade lightly contacts top of concrete block (Figure 3)

FIGURE 3



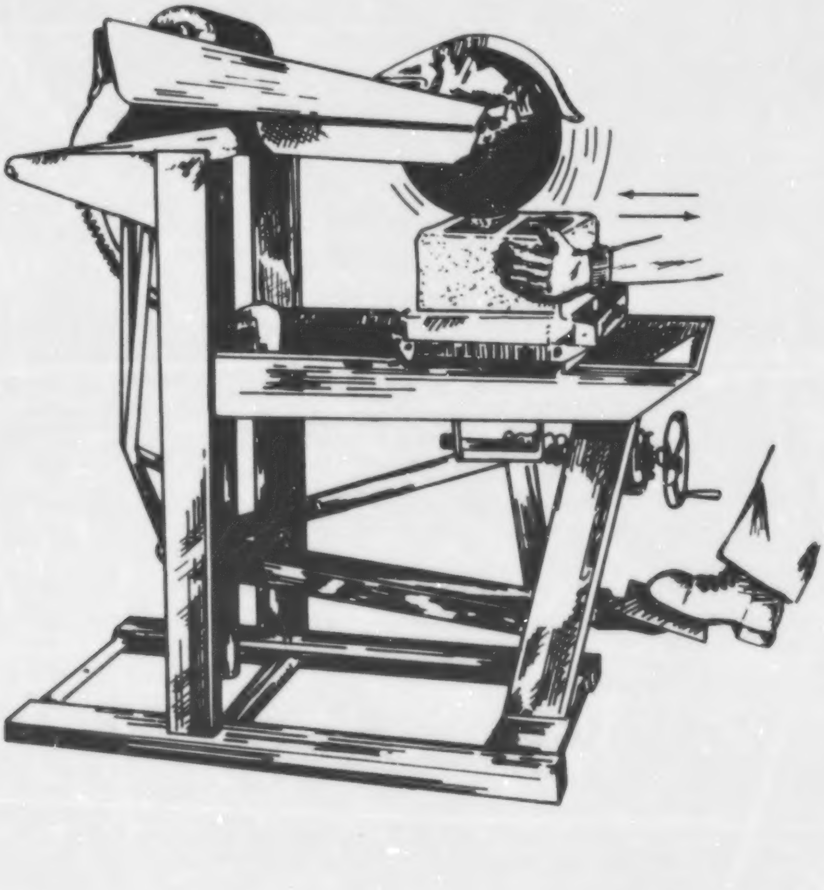
## JOB SHEET #1

K. Start step cutting

(NOTE: Always step cut when using an abrasive blade. Keep work area clean while cutting.)

1. Move concrete block rapidly forward under blade, with enough pressure on blade to cut approximately 1/8 inch deep the full length of block
2. Move concrete block rapidly backward so that blade will cut approximately 1/8 inch deeper (Figure 4)

FIGURE 4

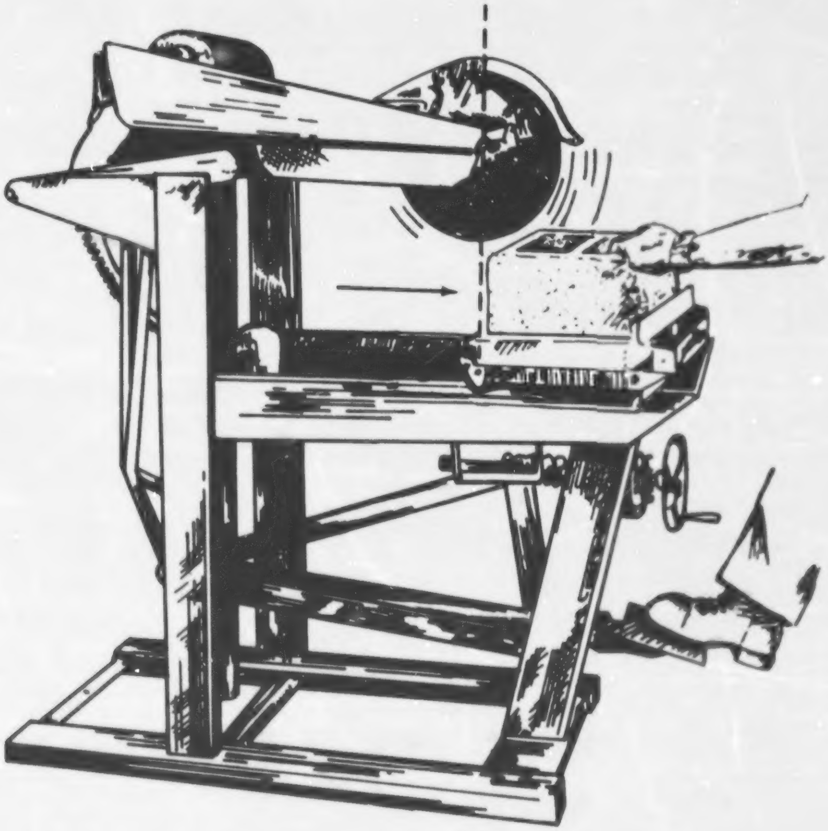


## JOB SHEET #1

3. Complete each stroke forward and backward, by passing concrete block beyond center of blade before starting reverse movement (Figure 5)

(NOTE: The harder the material is, the more rapid the forward and backward strokes should be. Step cutting lessens the area of the blade circumference in contact with the material, keeping the blade cool, running free, and cutting six times faster than trying to force the cut by strong-arming the material through the blade. Forcing the blade through with deep cuts causes a longer area of the blade circumference to be in contact with the material; therefore, excessive friction heat is generated and the blade is dulled.)

FIGURE 5



### JOB SHEET #1

4. Complete cut and turn off saw

   (NOTE: Cut will be slightly higher in the center and lower on each end. Masonry particles are freely and cleanly ejected from the cut, and there is free access of air into the cut to keep the blade cool and at peak efficiency.)

L. Clean work area; put away all equipment and materials

## POWER TOOLS
## UNIT II

## JOB SHEET #2 — WET CUT MASONRY UNIT, USING MASONRY SAW WITH DIAMOND BLADE

I. Equipment and materials

- A. Masonry saw
- B. Diamond blade for wet cutting
- C. Safety goggles
- D. Rubber gloves
- E. Rubber apron
- F. Water pump and water supply
- G. Water curtain
- H. Concrete block

II. Procedure for step cutting

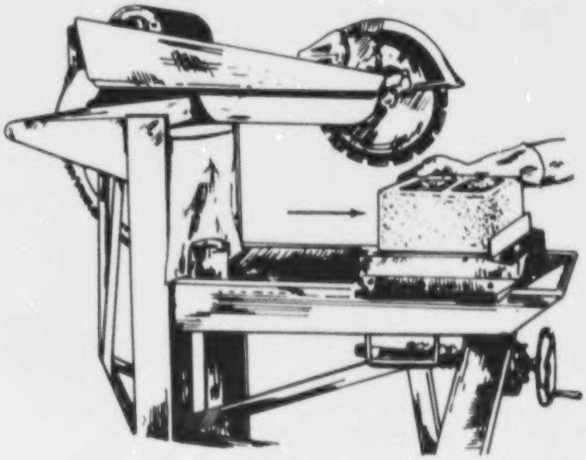
- A. Clean blade-shaft collars and arbors
- B. Mount diamond blade on shaft and secure
- C. Rotate blade to see that it is properly aligned
- D. Secure blade arm in a fixed position
- E. Put on safety and protective clothing and equipment
- F. Install water pump
- G. Turn on saw to make sure that pump is operating; then turn saw off

## JOB SHEET #2

H. Place concrete block on table and secure firmly against backstop (Figure 6)

**(CAUTION: If concrete block is allowed to slip, seizure of the blade may bend the blade or cause a rim section to be twisted off.)**

FIGURE 6



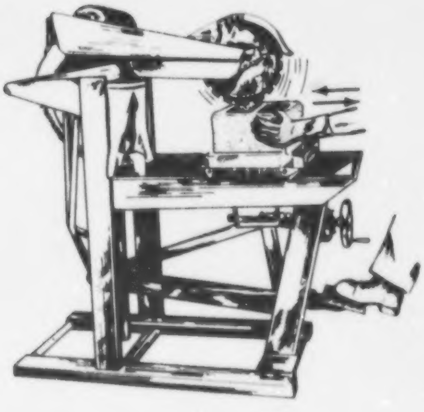
I. Start step cutting by moving concrete block beneath blade with rapid, full-length strokes

(NOTE: Step cutting with a diamond blade requires fewer strokes than step cutting with an abrasive blade.)

1. Complete each stroke forward and backward, by passing the concrete block beyond the center of the blade before starting the reverse movement (Figure 7)

   (NOTE: Keep work area clean while cutting.)

FIGURE 7



JOB SHEET #2

2. Continue procedure until block is completely cut

J. Turn off saw and release blade arm

III. Procedure for force cutting

A. Clean blade-shaft collars and arbors

B. Mount diamond blade on shaft and secure

C. Rotate blade to see that it is properly aligned

D. Put on safety and protective clothing and equipment

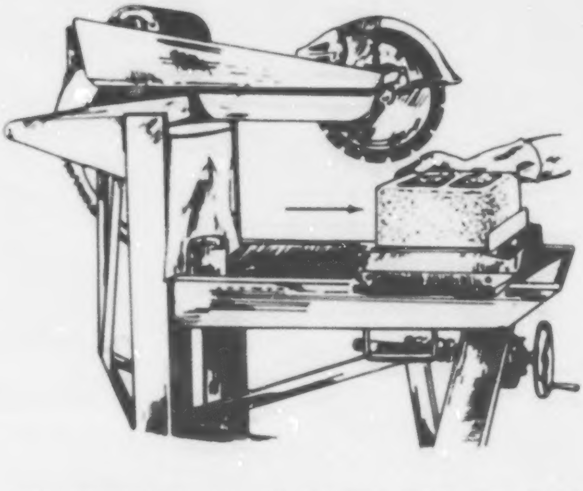
E. Install water pump

(NOTE: When wet cutting, water may be supplied by filling the water pan to within 1/2 inch of top or by placing a barrel of water next to saw. Using water from water pan causes same water to be used continously; using water from barrel causes clean water to be used continuously. To use water from barrel, remove pump from water pan and submerge pump in the water barrel. Remove drain plug from water pan so that used water and sludge will drain out.)

F. Turn on saw to make sure that pump is operating; then turn saw off

G. Place concrete block on table; secure firmly against backstop (Figure 8)

FIGURE 8

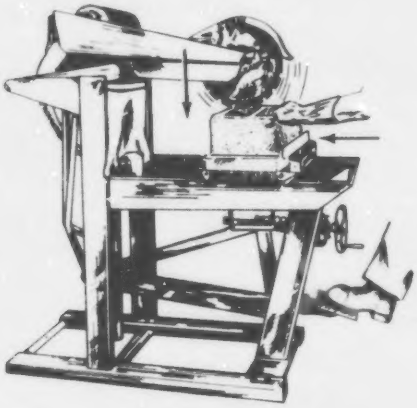


H. Move table forward until concrete block is near blade

## JOB SHEET #2

I. Push down on foot pedal until blade lightly contacts top of concrete block (Figure 9)

FIGURE 9



J. Turn on saw

K. Move table forward until concrete block comes in contact with blade

**(CAUTION: Do not force or bump material into blade.)**

L. Apply constant pressure as blade starts to cut

(NOTE: Only one cut will be made through the block.)

M. Retard pressure and hold back firmly as cut is completed

(NOTE: If constant pressure is held, the material may be pulled into the blade so fast that excessive pressure on blade may cause warping or twisting of the rim section.)

N. Turn saw off and release blade arm

O. Clean work area; put away all equipment and materials

(NOTE: At end of each day, diamond blade should be removed from saw and stored in a safe place.)

# POWER TOOLS
# UNIT II

## TEST

NAME ________________________________________ SCORE ________________

1. Match terms associated with power tools to their correct definitions. Write the correct numbers in the blanks.

______a. Machine used for mixing mortar

______b. To restrict movement

______c. Rubberized material that hangs on masonry saw just behind blade to keep blade from throwing water onto motor

______d. Power-driven saw used for cutting masonry units

______e. To damage or destroy by breaking or cracking

______f. Passing material beneath blade with rapid, full-length strokes at approximately fifty to sixty strokes per minute

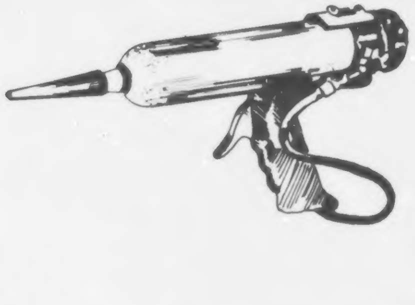
______g. Replacing old mortar in joints or patching joints with new mortar

______h. Groove in masonry unit into which a metal flashing is fitted; groove made to receive adjoining material

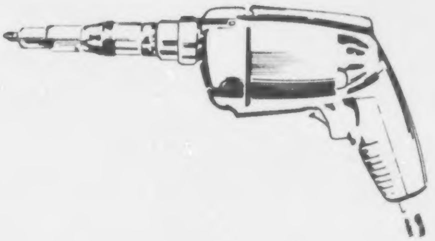
1. Masonry saw
2. Fracture
3. Tuck-pointing
4. Step cutting
5. Bind
6. Mortar mixer
7. Water curtain
8. Raggle

2. Identify the following power tools used by the bricklayer. Write the correct names in the blanks.

**Masonry saw**
**Mortar mixer**
**Portable masonry saw**
**Tuck-pointer grinder**
**Hammer drill**
**Air hammer**
**Dry-wall screwdriver**
**Pneumatic caulking gun**
**Pressure cleaner**

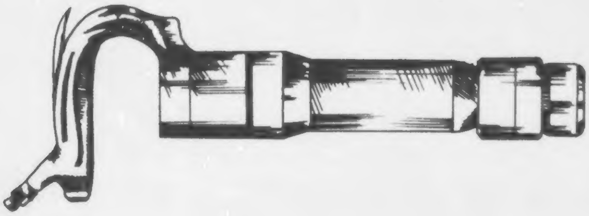


a. ______________________________

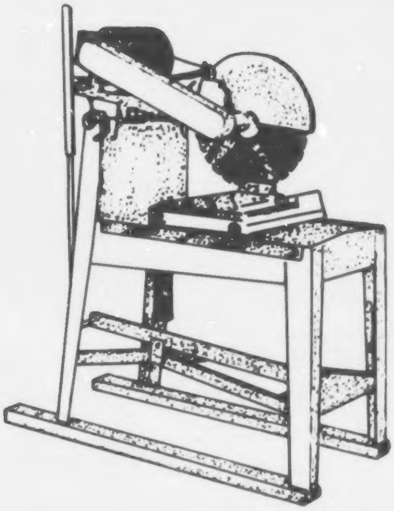


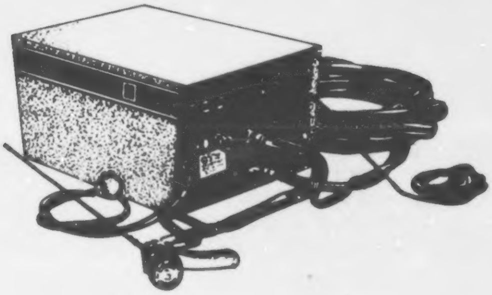
b. ______________________________

TEST



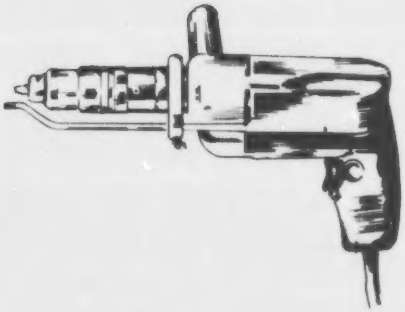
c. ______________________________

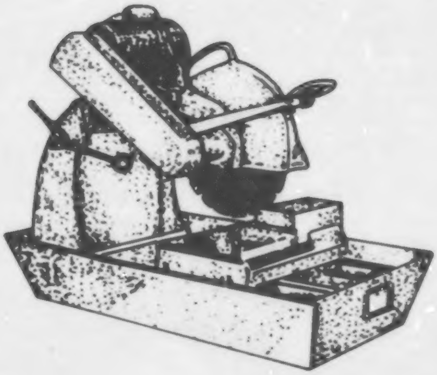




d. ______________________________ e. ______________________________

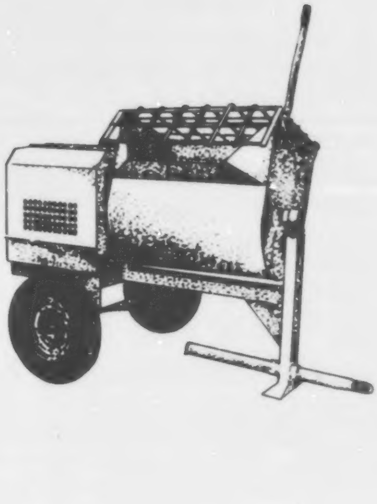
# TEST

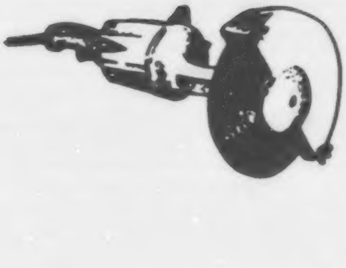




f. ______________________________

g. ______________________________





h. ______________________________

i. ______________________________

## TEST

3. Match power tools to their specific uses. Write the correct numbers in the blanks. Some numbers may be used more than once. Some blanks may contain more than one answer.

______a. Cutting holes

______b. Cutting raggle

______c. Cutting masonry units

______d. Drilling holes

______e. Washing masonry

______f. Removing mortar joints

______g. Chipping

______h. Attaching anchors and ties

______i. Applying caulking

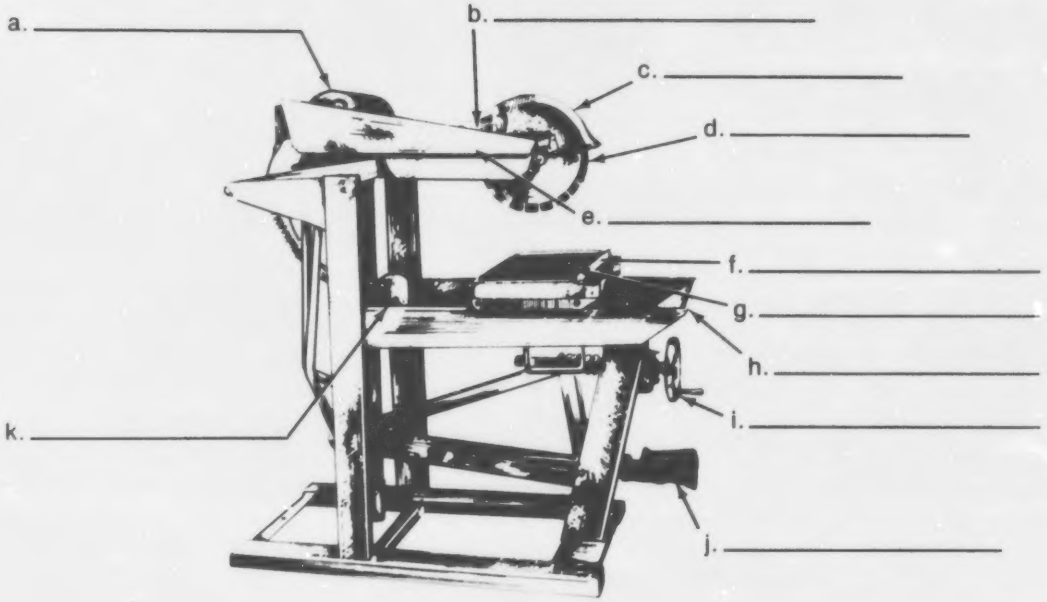
______j. Cleaning equipment

______k. Mixing mortar

1. Tuck-pointer grinder
2. Hammer drill
3. Pressure cleaner
4. Masonry saw
5. Pneumatic caulking gun
6. Air hammer
7. Mortar mixer
8. Dry-wall screwdriver

## TEST

4. Label the parts of the masonry saw illustrated below.


a.
b.
c.
d.
e.
f.
g.
h.
i.
j.
k.

## TEST

5. Name types of cutting blades used on masonry saws.

   a. ________________

   b. ________________

   c. ________________

6. List four factors to consider when caring for the masonry saw.

   a. ________________

   b. ________________

   c. ________________

   d. ________________

7. State seven safety rules pertaining to the use of the masonry saw.

   a. ________________

   b. ________________

   c. ________________

   d. ________________

   e. ________________

   f. ________________

   g. ________________

(NOTE: Test question 8 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

8. Demonstrate the ability to

   a. Dry cut masonry unit, using masonry saw with abrasive blade.

   b. Wet cut masonry unit, using masonry saw with diamond blade.

## POWER TOOLS
## UNIT II

### ANSWERS TO TEST

1.

| | | | |
|---|---|---|---|
| a. | 6 | e. | 2 |
| b. | 5 | f. | 4 |
| c. | 7 | g. | 3 |
| d. | 1 | h. | 8 |

2.

| | | | |
|---|---|---|---|
| a. | Pneumatic caulking gun | f. | Hammer drill |
| b. | Dry-wall screwdriver | g. | Portable masonry saw |
| c. | Air hammer | h. | Mortar mixer |
| d. | Masonry saw | i. | Tuck-pointer grinder |
| e. | Pressure cleaner | | |

3.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | 6 | d. | 2 | g. | 2, 6 | j. | 3 |
| b. | 1 | e. | 3 | h. | 8 | k. | 7 |
| c. | 4 | f. | 1 | i. | 5 | | |

4.

| | | | |
|---|---|---|---|
| a. | Motor | g. | Table (conveyor) |
| b. | On/off switch | h. | Water pan |
| c. | Blade guard | i. | Blade adjustment wheel |
| d. | Blade | j. | Foot pedal |
| e. | Blade arm | k. | Water pump |
| f. | Table backstop (conveyor backstop) | | |

5. a. Diamond blade for wet cutting
   b. Abrasive blade for dry cutting
   c. Combination blades for wet or dry cutting

# ANSWERS TO TEST

6. Answer should include any four of the following
    a. Keep dust removed from saw
    b. Keep table clean and free of debris
    c. Keep parts lubricated
    d. Keep water pan free of debris
    e. Clean water pan and pump daily
    f. Check table wheels and wheel adjustment weekly

7. Answer should include any seven of the following
    a. Wear goggles, gloves, and respirator or dust mask when dry cutting
    b. Wear goggles, rubber gloves, and rubber apron when wet cutting
    c. Keep hands away from blade
    d. Keep work area clean
    e. Inspect blade for damage before installing
    f. Clean and inspect blade-shaft collars and arbors before installing blade
    g. Tighten nut on blade shaft just enough to hold blade securely; do not overtighten
    h. Operate blade within specified maximum operating speed
    i. Stand to outside of blade path when starting saw
    j. Hold materials securely when making cuts

8. Performance skills evaluated to the satisfaction of the instructor

# MISCELLANEOUS EQUIPMENT
## UNIT III

## UNIT OBJECTIVE

After completing this unit, the student should be able to identify miscellaneous equipment and use hand signals correctly. The student will show this knowledge by completing assignment sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with miscellaneous equipment.
2. Identify miscellaneous equipment related to bricklaying.
3. Identify types of scaffolds.
4. Name safety rules pertaining to scaffolds.
5. Identify the parts of a stationary scaffold.
6. Label hand signals used in moving equipment and materials.
7. Label hand signals used in forklift operations.
8. Label devices and types of rigging used to handle panels.
9. State the importance of spreading sling angles.
10. Calculate sling stress.
11. Select from a list good rigging practices.

# MISCELLANEOUS EQUIPMENT
## UNIT III

## SUGGESTED ACTIVITIES

I. Suggested activities

- A. Obtain transparencies.

  (NOTE: Transparencies are available through AGC and CIMC.)

- B. Provide students with objective sheet.
- C. Discuss unit and specific objectives.
- D. Provide students with information and assignment sheets.
- E. Discuss information and assignment sheets.
- F. Have students practice giving and reading hand signals until they become proficient.
- G. Give test.
- H. Complete appropriate section of competency profiles.

  (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

- A. Objective sheet
- B. Suggested activities
- C. Information sheet
- D. Transparency masters
  1. TM #1 — Types of Scaffolds
  2. TM #2 — Parts of a Stationary Scaffold
  3. TM #3 — Sling Angle and Load Factors
  4. TM #4 — Sling Angle
  5. TM #5 — Formula for Calculating Sling Stress
- E. Assignment Sheets
  1. Assignment Sheet #1 — Distinguish Among Hand Signals Used in Moving Equipment and Materials
  2. Assignment Sheet #2 — Distinguish Among Hand Signals Used in Forklift Operations

## SUGGESTED ACTIVITIES

3. Assignment Sheet #3 — Calculate Sling Stress

F. Answers to assignment sheets

G. Test

H. Answers to test

III. Unit references

A. *Goldblatt Catalog.* Kansas City, Kansas: Goldblatt Tool Co., 1982.

B. Hendrix, Laborn J. "Bud." *Construction Craftsman's Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1978.

C. Hendrix, Laborn J. "Bud." *Heavy Equipment Operator, Basic Core.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1981.

D. Indiana Limestone Institute of America, Inc. *ILI Handbook.* Bedford, Indiana, 1982-1983.

E. Kreh, R.T., Sr. *Masonry Skills.* Albany, New York: Delmar Publishers, Inc., 1982.

F. *Tools and Equipment Catalog.* Gibsonia, Pennsylvania: Masonry Specialty Co., 1983.

G. Turcotte, Raymond J. *Bricklaying Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1977.

# MISCELLANEOUS EQUIPMENT
## UNIT III

## INFORMATION SHEET

I. Terms and definitions

   A. Conveyor — Continuous chain or belt that moves material from one location to another, usually from ground level to an upper floor level

   B. Material hoist — Elevator-type machine used for lifting material from low to high elevations

   C. Mortar hod — Portable trough for carrying mortar or masonry units; fixed crosswise on top of a pole and carried on the shoulder

   D. Mortar tub — Wheeled container designed to hold mortar; can be moved freely from mixer to work site, eliminating wheelbarrows and mortar boxes

   E. Power buggy — Engine-powered vehicle used to move materials

   F. Scaffold — Temporary structure or platform used to support workers and materials at each staging height during construction

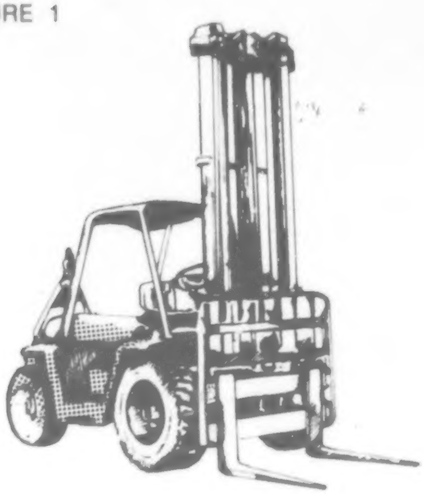
   G. Staging height — Normally every five feet of vertical construction

   H. Whipline — Single-load line

II. Miscellaneous equipment related to bricklaying (Figures 1-12)

   A. Forklift

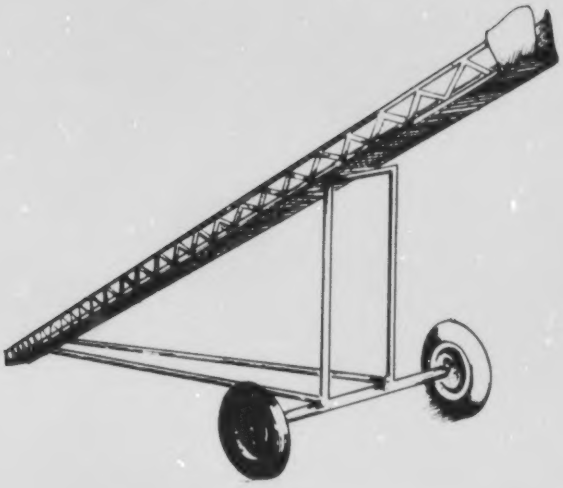
FIGURE 1



## INFORMATION SHEET

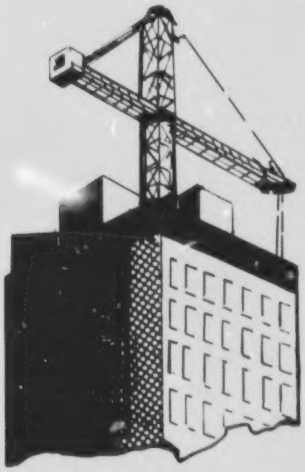
B. Conveyor

FIGURE 2



C. Tower crane

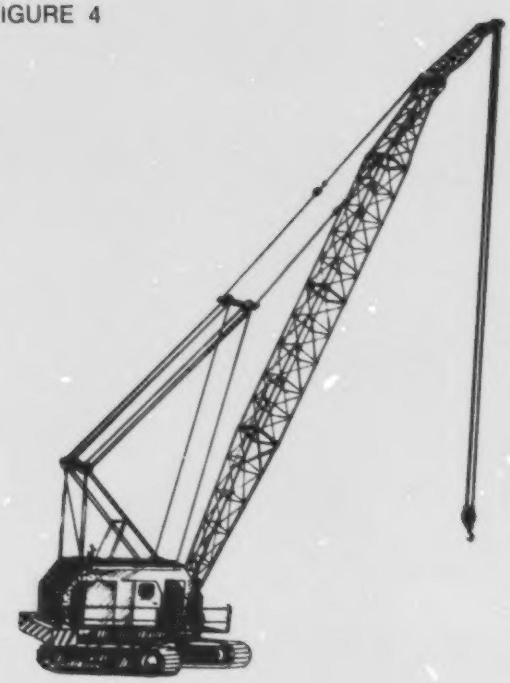
FIGURE 3



## INFORMATION SHEET

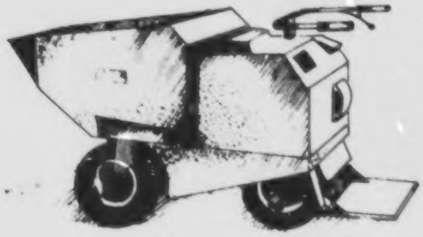
D. Crawler crane

FIGURE 4



E. Power buggy

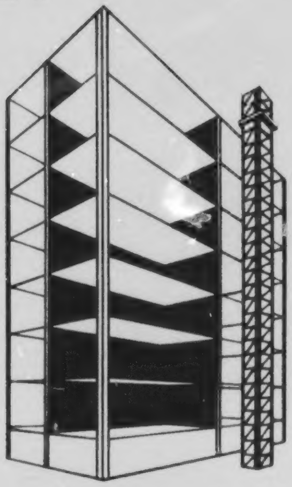
FIGURE 5



## INFORMATION SHEET

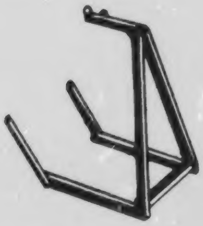
F. Material hoist

FIGURE 6



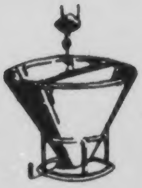
G. Hoist fork

FIGURE 7



H. Hoist bucket

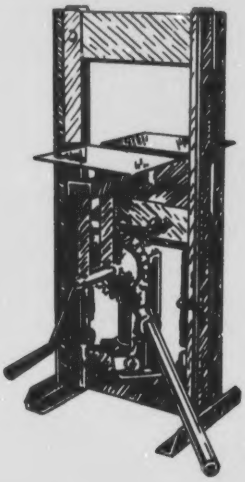
FIGURE 8



# INFORMATION SHEET

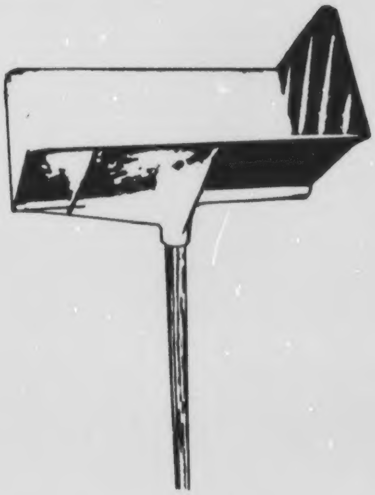
I. Masonry splitter

FIGURE 9



J. Mortar hod

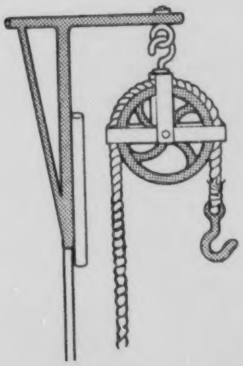
FIGURE 10



## INFORMATION SHEET

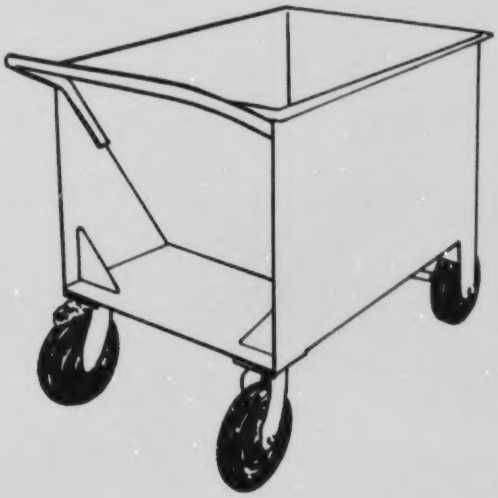
K. Well wheel and boom

FIGURE 11



L. Mortar tub

FIGURE 12

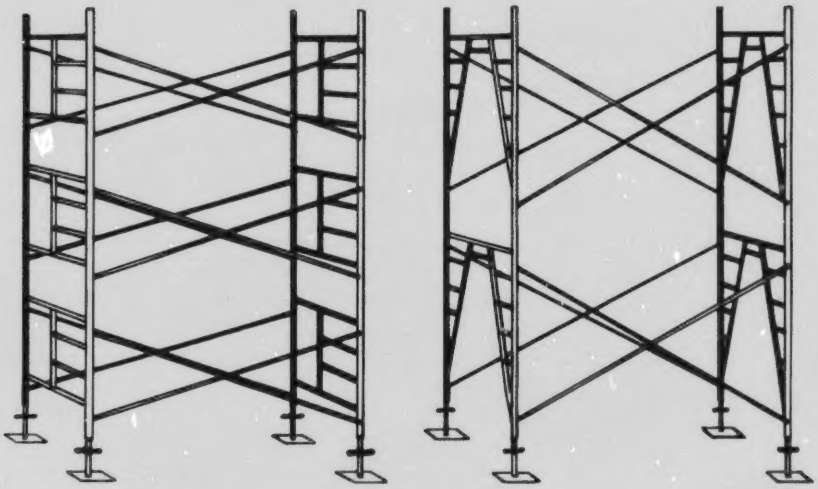


## INFORMATION SHEET

III. Types of scaffolds (Figures 13-15; Transparency #1)

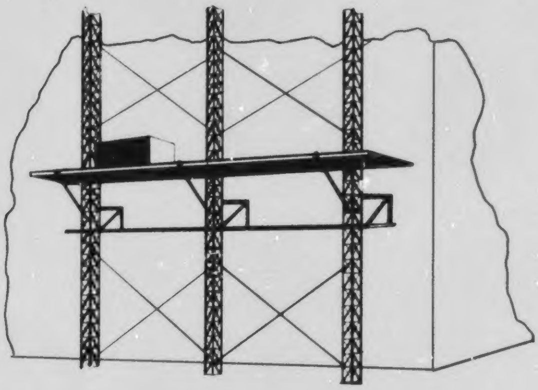
A. Stationary steel sectional

FIGURE 13



B. Adjustable

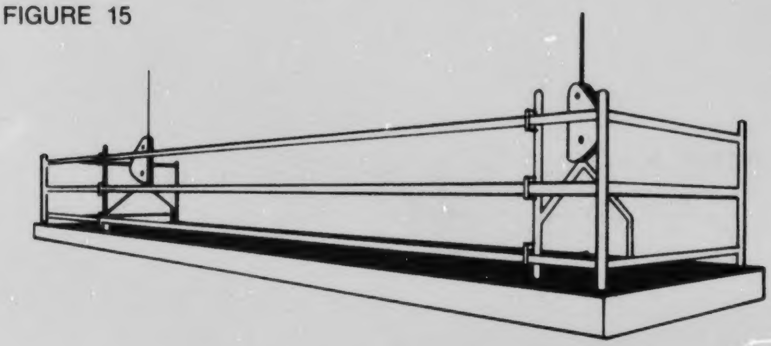
FIGURE 14



INFORMATION SHEET

C. Swing stage or suspended

FIGURE 15



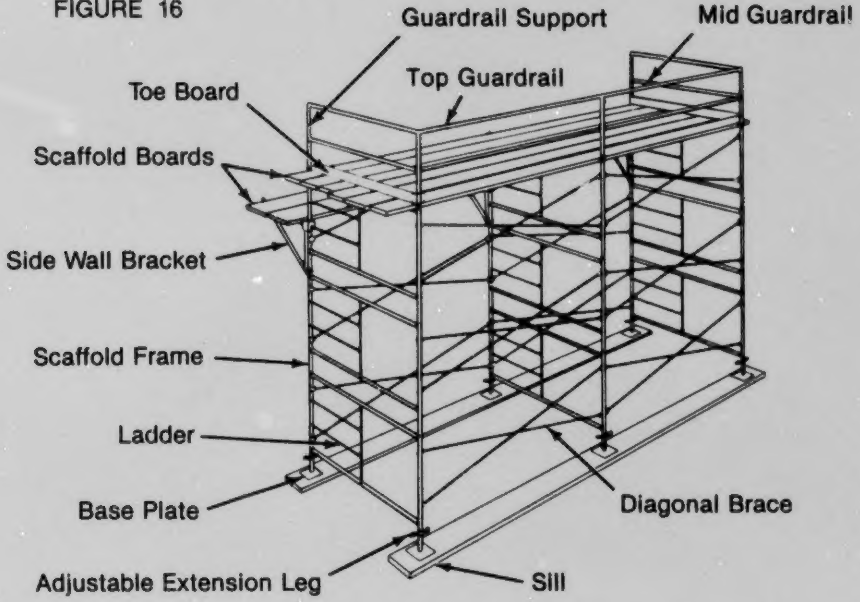
IV. Safety rules pertaining to scaffolds

- A. Maintain OSHA regulations
- B. Inspect scaffolds regularly
- C. Keep scaffolds plumb and level
- D. Install all braces and accessories according to manufacturer's recommendation
- E. Install anchors and guy wires on free-standing scaffolds
- F. Do not overload scaffolds
- G. Wear proper safety belt or harness when working on scaffolds
- H. Be sure that all safety rails are installed

## INFORMATION SHEET

V. Parts of a stationary scaffold (Figure 16; Transparency #2)

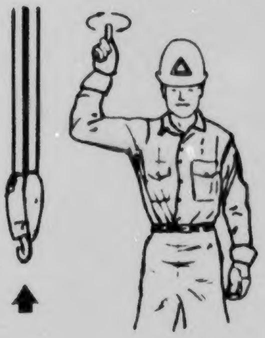
FIGURE 16


Guardrail Support
Mid Guardrail
Toe Board
Top Guardrail
Scaffold Boards
Side Wall Bracket
Scaffold Frame
Ladder
Base Plate
Diagonal Brace
Adjustable Extension Leg
Sill

VI. Hand signals used when moving equipment and materials (Figures 17-34)

A. Hoist the load

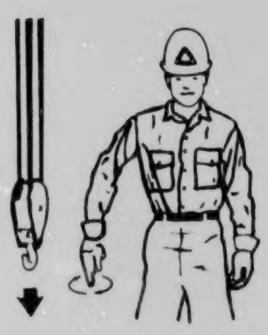
FIGURE 17



Forearm vertical, forefinger pointing up; move hand in small, horizontal circle

B. Lower the load

FIGURE 18

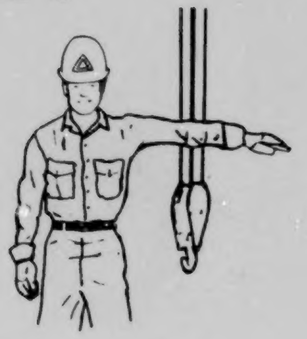


Arm extended downward, forefinger pointing down; move hand in small, horizontal circle

## INFORMATION SHEET

### C. Stop

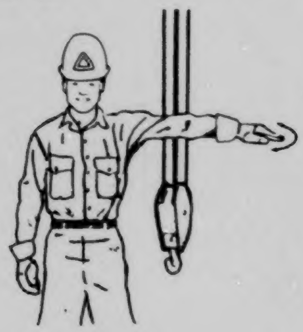
FIGURE 19



Arm extended, palm down; hold position rigidly

### D. Emergency stop

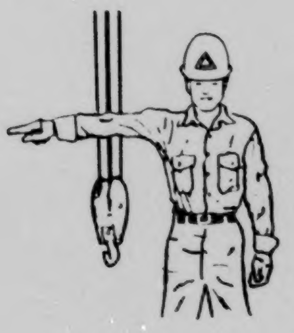
FIGURE 20



Arm extended, palm down; move hand rapidly right and left

### E. Swing

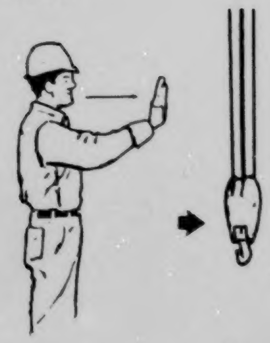
FIGURE 21



Arm extended, point with finger in direction of swing of boom

### F. Travel

FIGURE 22

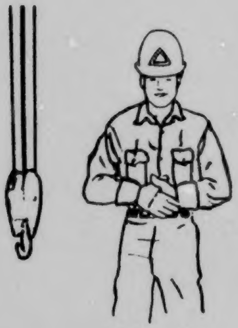


Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel

## INFORMATION SHEET

G. Dog everything

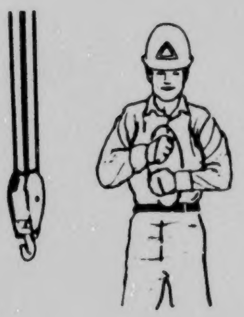
FIGURE 23



Clasp hands in front of body

H. Travel (both tracks)

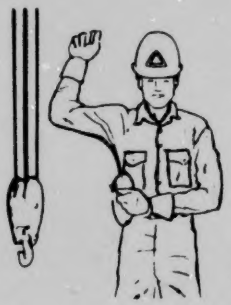
FIGURE 24



Use both fists in front of body, making a circular motion about each other indicating direction of travel: forward or backward (crawler cranes only)

I. Travel (one track)

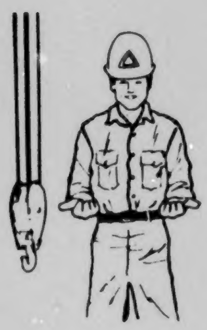
FIGURE 25



Lock track on side indicated by raised fist; travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body (for crawler cranes only)

J. Extend boom

FIGURE 26

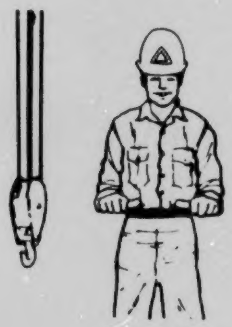


Both fists in front of body with thumbs pointing outward

# INFORMATION SHEET

K. Retract boom

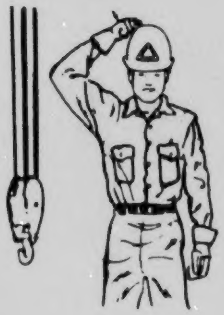
FIGURE 27



Both fists in front of body with thumbs pointing toward each other

L. Use main hoist

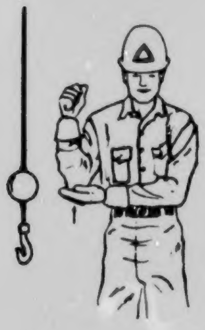
FIGURE 28



Tap fist on head; then use regular signals

M. Use whipline

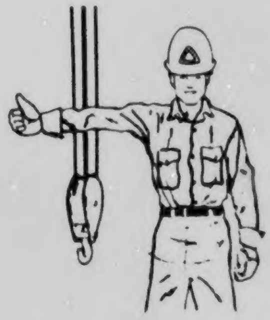
FIGURE 29



Tap elbow with one hand; then use regular signals

N. Raise boom

FIGURE 30

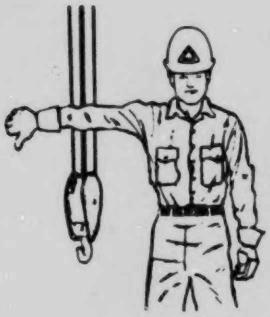


Arm extended, fingers closed, thumb pointing upward

## INFORMATION SHEET

O. Lower boom

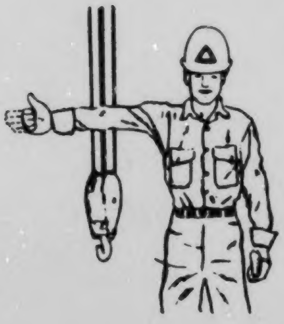
FIGURE 31



Arm extended, fingers closed, thumb pointing downward

P. Raise boom and lower load

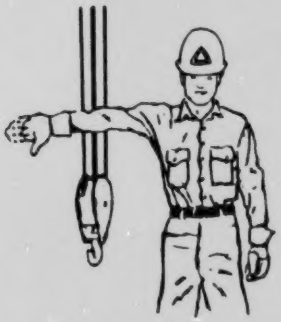
FIGURE 32



Arm extended, thumb pointing up; flex fingers in and out as long as load movement is desired

Q. Lower boom and raise load

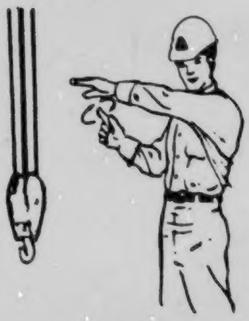
FIGURE 33



Arm extended, thumb pointing down; flex fingers in and out as long as load movement is desired

R. Move slowly

FIGURE 34

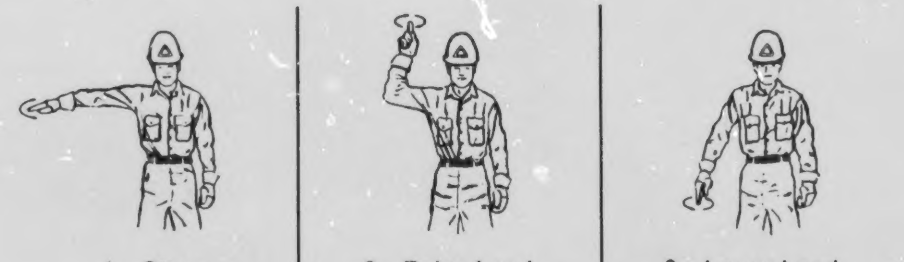


Use one hand to give any motion signal; place other hand motionless in front of hand giving the motion signal (hoist slowly shown as example)

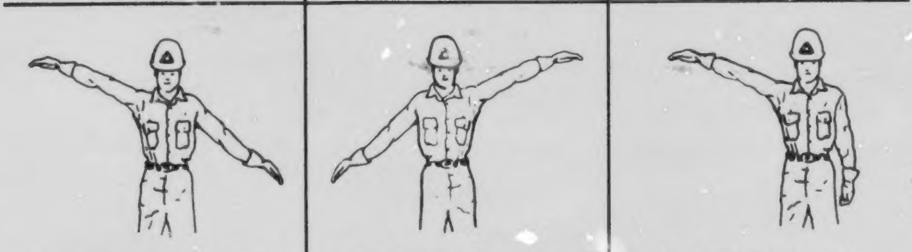
## INFORMATION SHEET

VII. Hand signals used in forklift operations (Figure 35)

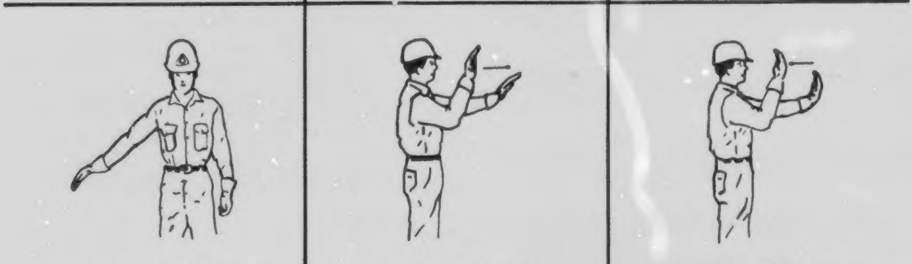
FIGURE 35



1. Stop
2. Raise Load
3. Lower Load



4. Tilt Forks Right
5. Tilt Forks Left
6. Tilt Forks Up



7. Tilt Forks Down
8. Move Load Backward
9. Move Load Forward

### INSTRUCTIONS TO SIGNAL PERSON

1. Only one person to be signal person
2. Make sure the operator can see you and is able to acknowledge the signal given
3. Signal person must watch the load — the operator is watching you
4. Never raise or lower load over other workers; warn them to keep out of the way

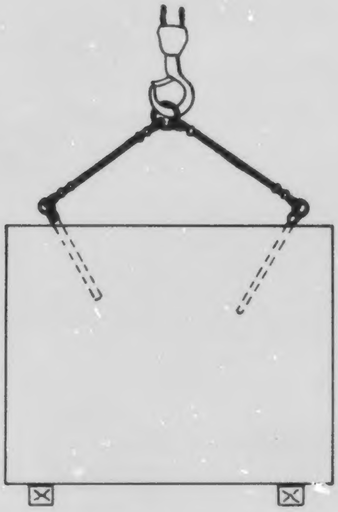
WATCH FOR OVERHEAD LINES OR OTHER OBSTRUCTIONS.

## INFORMATION SHEET

VIII. Devices and types of rigging used to handle panels (Figures 36-46)

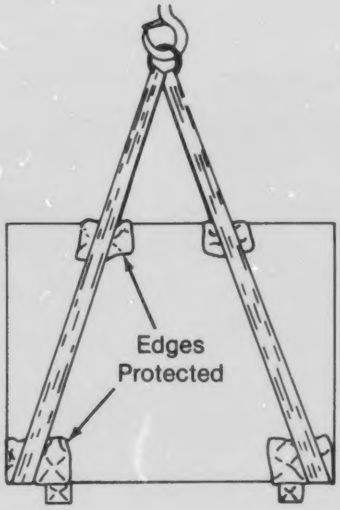
A. Lewis pins and bridle

FIGURE 36



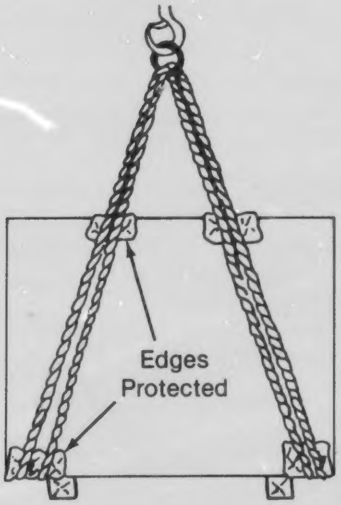
B. Straps or web slings

FIGURE 37


Edges Protected

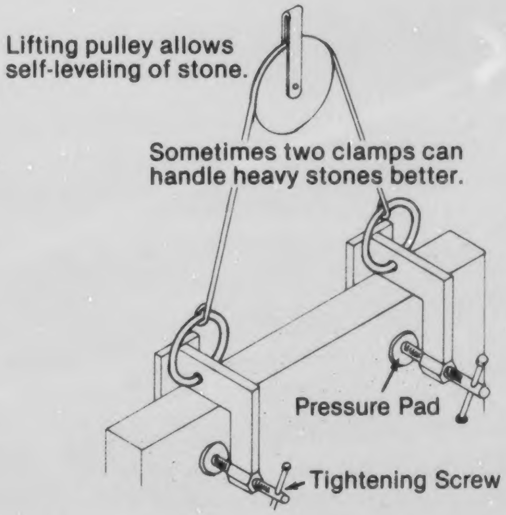
C. Chokers or slings

FIGURE 38


Edges Protected

D. Stone clamps

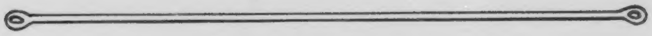
FIGURE 39


Lifting pulley allows self-leveling of stone.
Sometimes two clamps can handle heavy stones better.
Pressure Pad
Tightening Screw

## INFORMATION SHEET

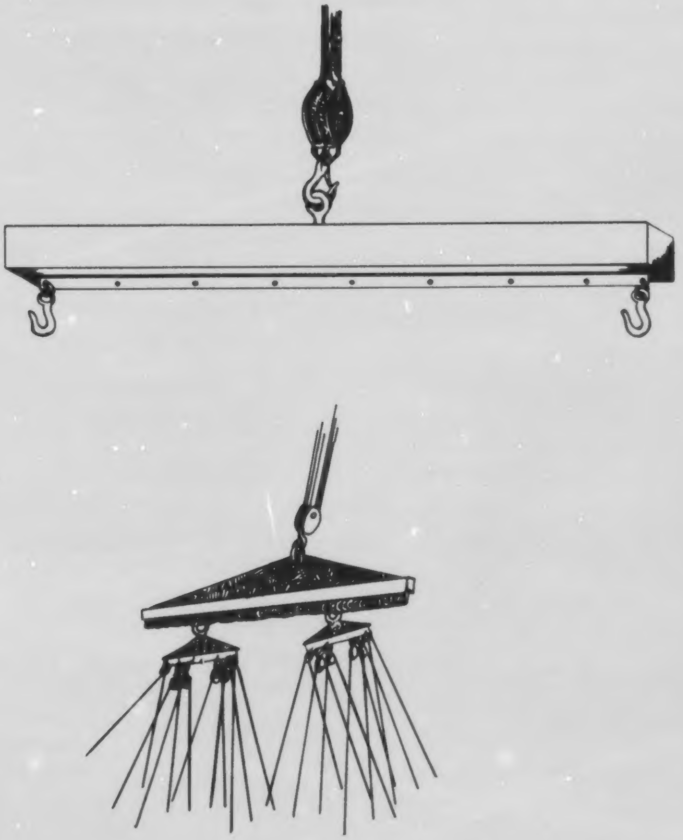
E. Spreader

FIGURE 40



F. Spreader bars

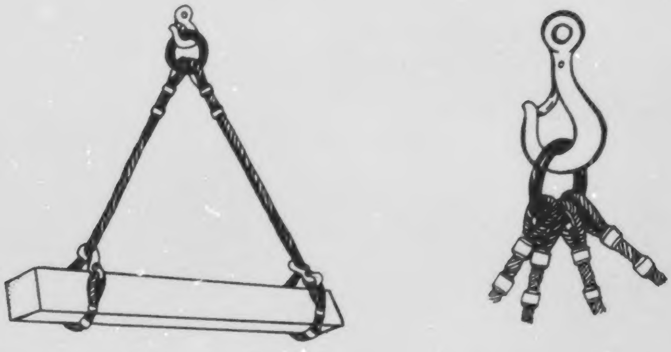
FIGURE 41



# INFORMATION SHEET

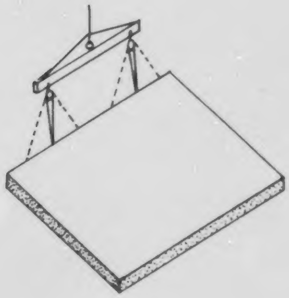
G. **Bridles**

FIGURE 42



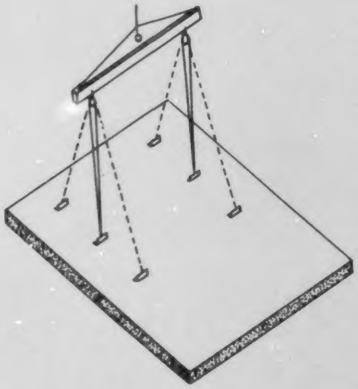
H. **Basic edge lift**

FIGURE 43



I. **Basic two-point lift**

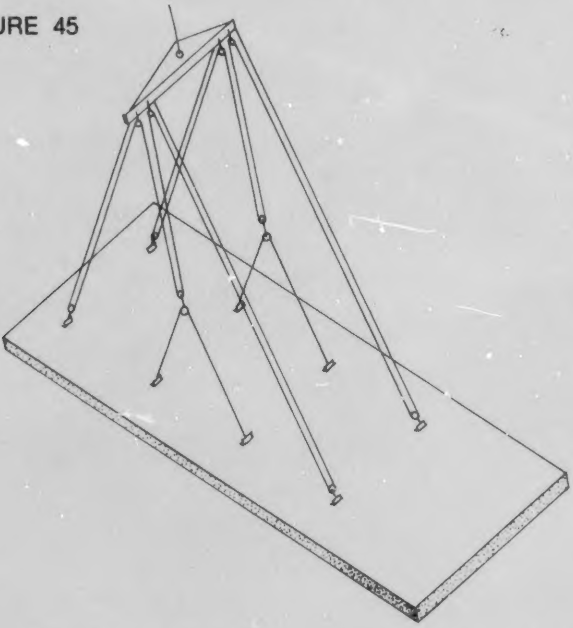
FIGURE 44



## INFORMATION SHEET

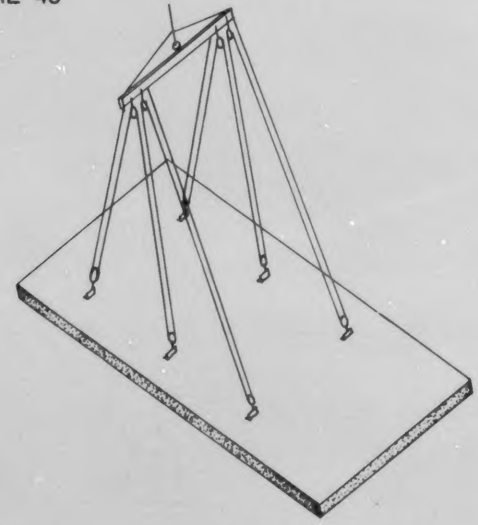
J. High rigging with approximately equal loads

FIGURE 45



K. High rigging modified for panels of various widths

FIGURE 46



## INFORMATION SHEET

IX. Importance of spreading sling angles (Figure 47; Transparencies #4 and #5)

A. Changing angle of sling leg may increase stress on sling

B. As angle is reduced, lifting capacity is reduced very rapidly

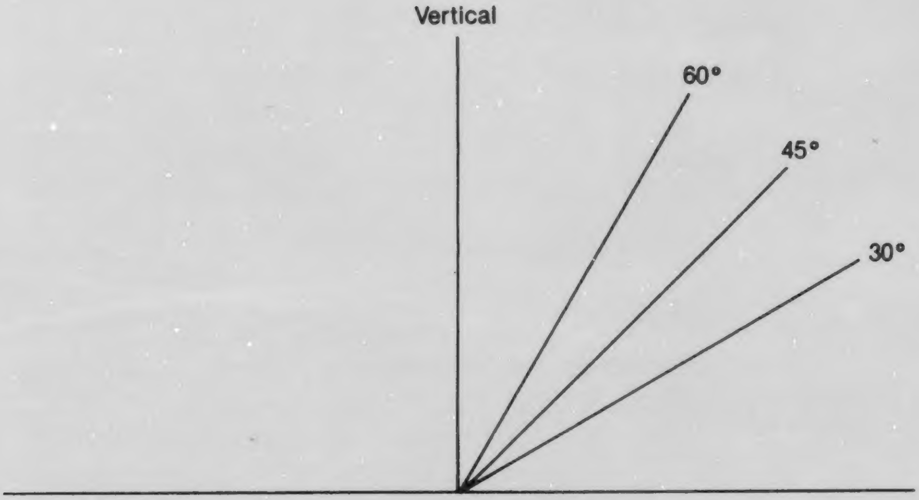
C. When single leg of sling is at 60-degree angle, lifting capacity is only 87 percent of that of a vertical leg

D. When single leg of sling is at 45-degree angle, lifting capacity is only 71 percent of that of a vertical leg

E. When single leg of sling is at 30-degree angle, lifting capacity is only 50 percent of that of a vertical leg

EXAMPLE:

FIGURE 47



## INFORMATION SHEET

X. Formula for calculating sling stress (Transparency #5; Assignment Sheet #3)

$$\frac{W \times L}{H \times N} = S$$

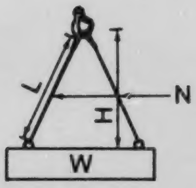
W = Weight of load

L = Length of sling

H = Height of load

N = Number of sling legs

EXAMPLE:



W = 10
L = 6′
H = 4′
N = 2

$$\frac{10 \times 6}{2 \times 4} = \frac{60}{8} = 7\,{}^{1}\!/_{2} \text{ tons}$$

Stress = 7 ½ tons each sling

XI. Good rigging practices

A. Turn hooks out

B. Use shackles on chokers where there may be cutting action

C. Pad all sharp corners and edges

D. Always make vertical lifts on eye bolts

(NOTE: Lifting at an angle reduces safe load as much as 90 percent.)

E. Use thimble in eye splices

F. Use a shackle whenever two or more ropes are to be used over a hook

G. Use tagline to control loads

H. Secure all unused sling lines

I. Never wrap a rope around a hook

J. Do not permit bending of rope near a splice or attached fitting

K. Block all loads properly before unhooking

L. Never allow a shackle to be pulled at an angle

(NOTE: Use washers for packing if necessary.)

INFORMATION SHEET

M. Do not use screw pin shackle if the pin can roll under load and unscrew

N. Center crane over load before lifting

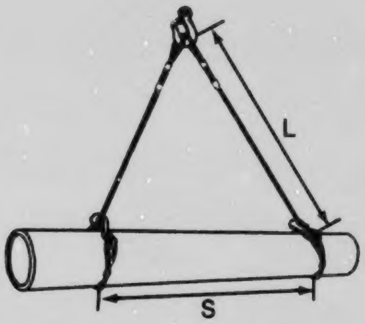
O. Give all hand signals clearly and correctly

P. Keep machines at least 10 feet from all electrical equipment

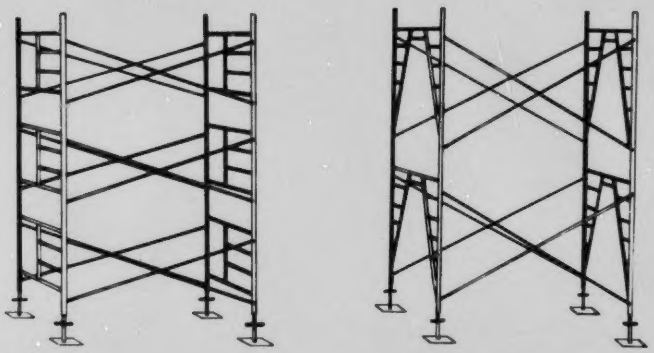
Q. For proper sling angle, be sure that length of slings is always greater than span between the two connections (Figure 48)

EXAMPLE: L (length of sling) is greater than S (span)

FIGURE 48



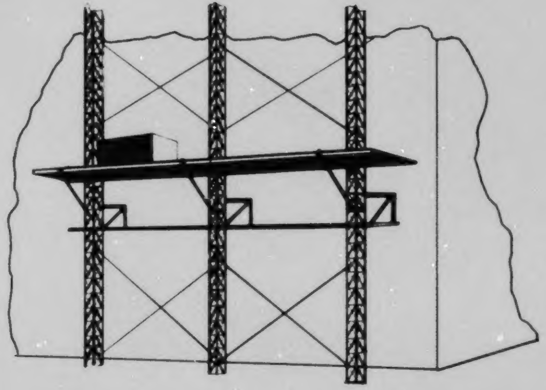
# Types of Scaffolds



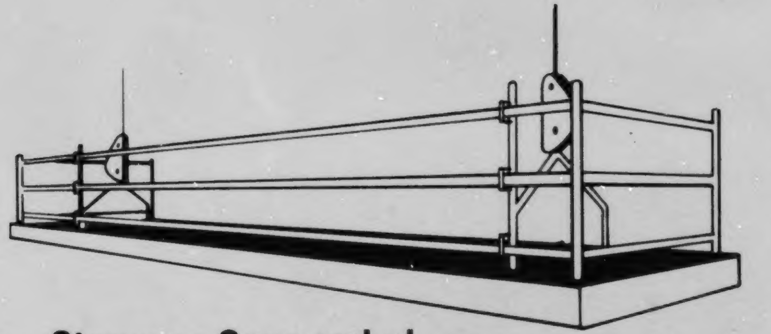
Single Box

Walk Through

**Stationary Steel Sectional**

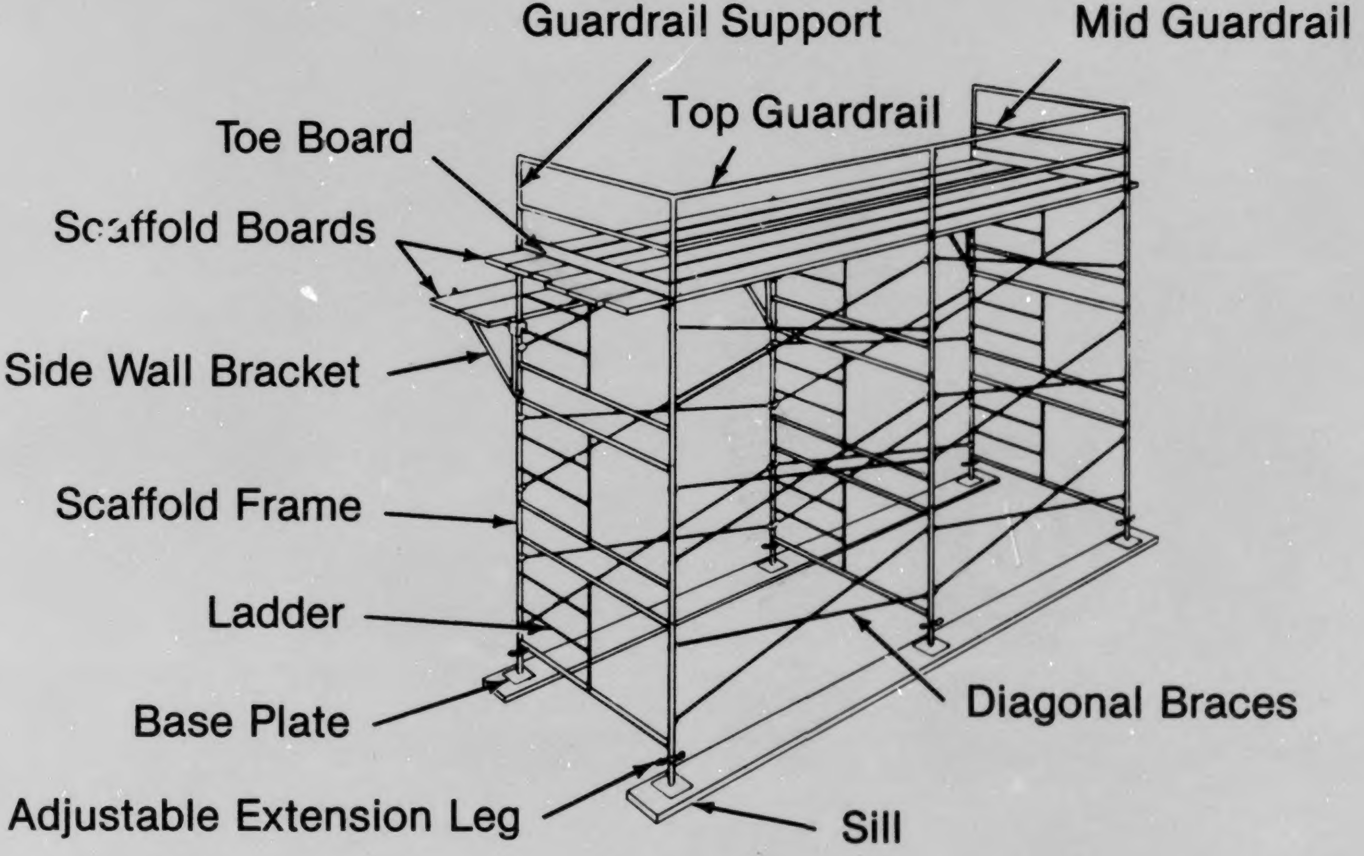


**Adjustable**



**Swing Stage or Suspended**

# Parts of a Stationary Scaffold


Guardrail Support
Mid Guardrail
Top Guardrail
Toe Board
Scaffold Boards
Side Wall Bracket
Scaffold Frame
Ladder
Base Plate
Adjustable Extension Leg
Sill
Diagonal Braces

# Sling Angles and Load Factors

| Sling Angles | Load Angle Factors |
|---|---|
| 0°(Vertical) | 1.000 |
| 15° | 1.035 |
| 20° | 1.064 |
| 25° | 1.104 |
| 30° | 1.155 |
| 35° | 1.221 |
| 40° | 1.305 |
| 45° | 1.414 |
| 50° | 1.555 |
| 55° | 1.742 |
| 60° | 2.000 |

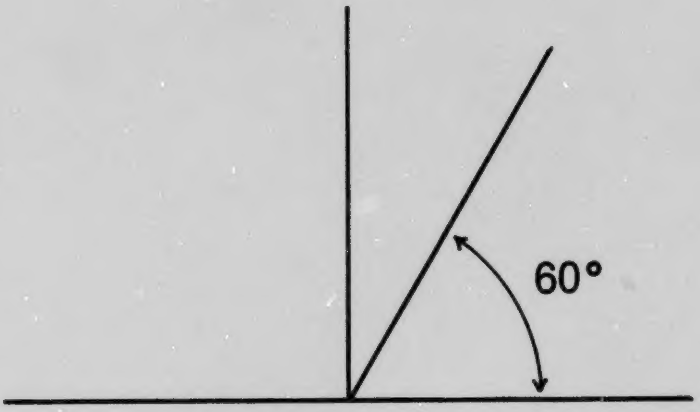
# Sling Angle

Critical Angle — Sling Angle That Exists When the Tension in the Sling Leg Equals the Weight of the Load

Critical Angle Formula

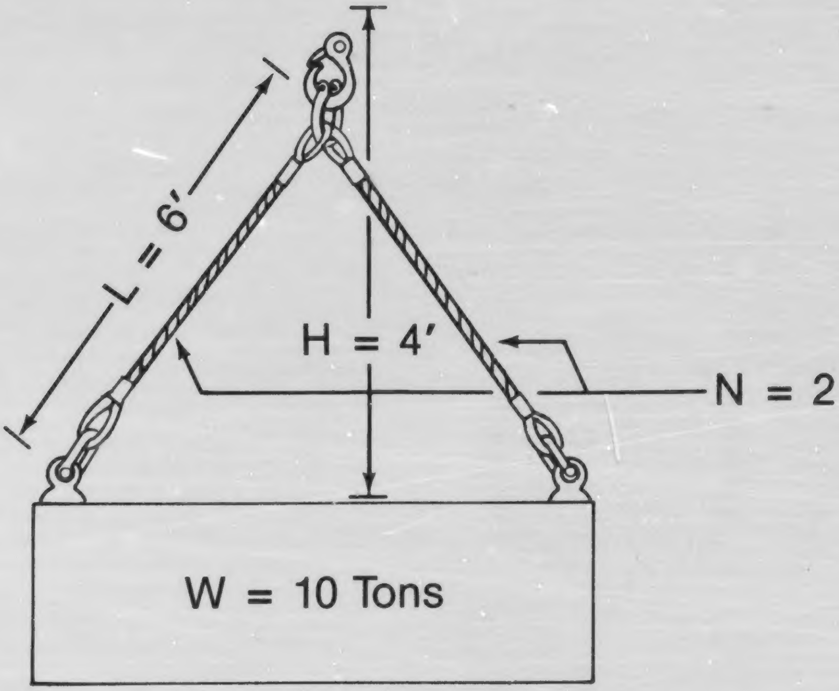
$$CA = \frac{60°}{N}$$

Vertical



N = Number of Sling Legs

# Formula for Calculating Sling Stress


L = 6′
H = 4′
N = 2
W = 10 Tons

$$S = \frac{W \times L}{H \times N}$$

$$S = \frac{10 \times 6}{2 \times 4}$$

$$S = \frac{60}{8}$$

S = 7 1/2 Tons

## MISCELLANEOUS EQUIPMENT
## UNIT III

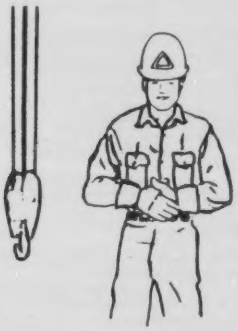
## ASSIGNMENT SHEET #1 — DISTINGUISH AMONG HAND SIGNALS USED IN MOVING EQUIPMENT AND MATERIALS

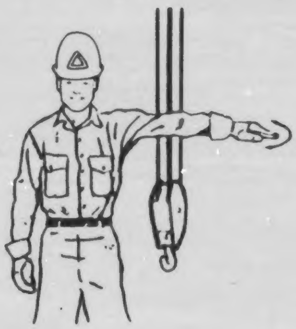
NAME ____________________________________________ SCORE ________________

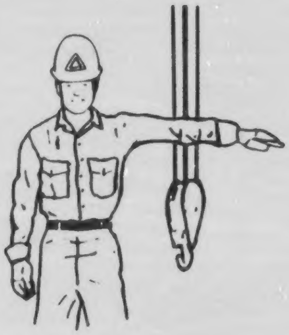
It is important for the bricklayer to know how to use hand signals. Knowing hand signals and using them correctly enables the worker to assist in moving and stocking materials, to help another worker get out of a bad situation in an emergency, and possibly to avoid a serious accident.

Distinguish among the following hand signals by writing an "X" in the blanks below the correct illustrations.

A. Emergency stop

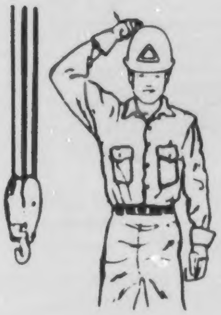


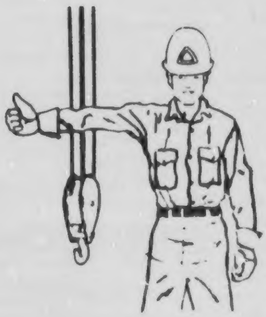


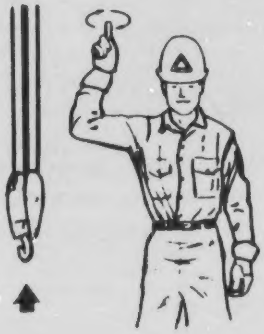


1. ____________________ 2. ____________________ 3. ____________________

B. Hoist the load



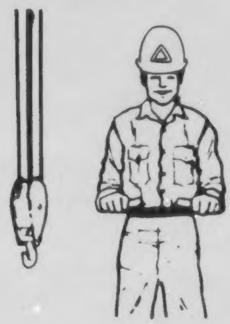
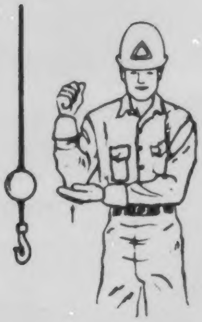
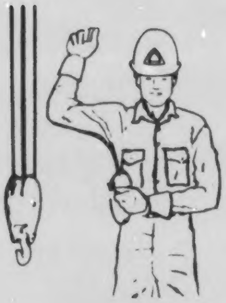




1. ____________________ 2. ____________________ 3. ____________________

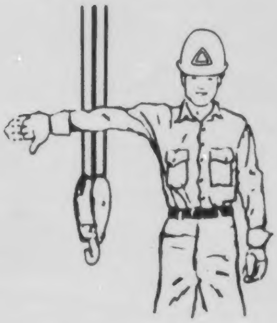
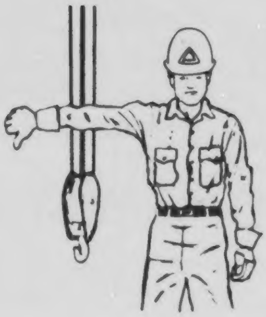
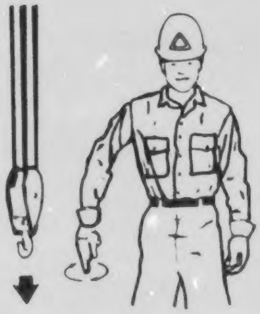
## ASSIGNMENT SHEET #1

C. Retract boom

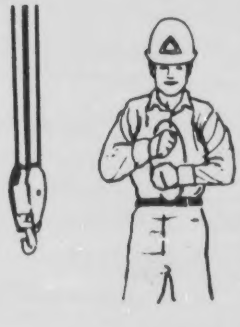
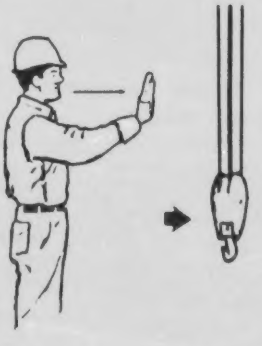
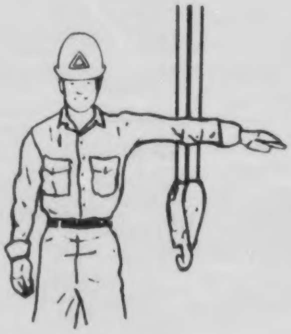
1. ____________________ 2. ____________________ 3. ____________________

D. Lower boom and raise load

1. ____________________ 2. ____________________ 3. ____________________

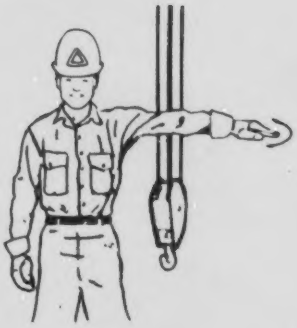
E. Travel

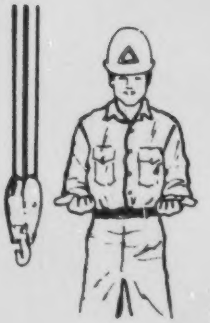




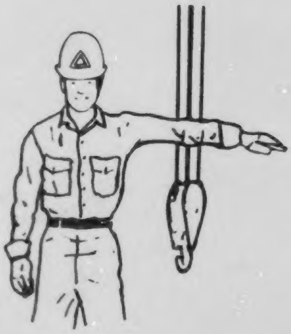
1. ____________________ 2. ____________________ 3. ____________________

## ASSIGNMENT SHEET #1

F. Stop

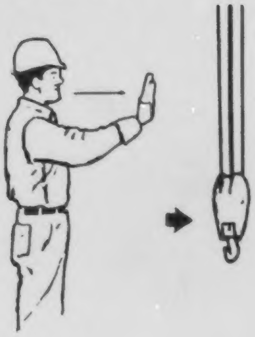


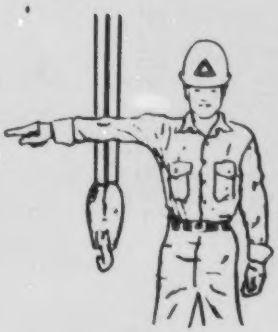


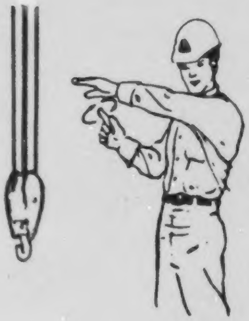


1. ________________ 2. ________________ 3. ________________

G. Move slowly

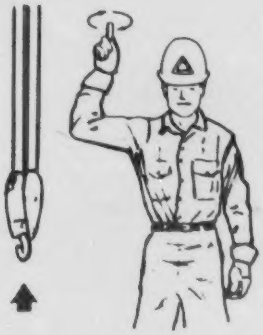


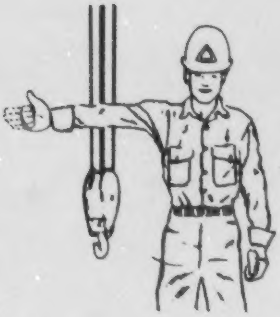


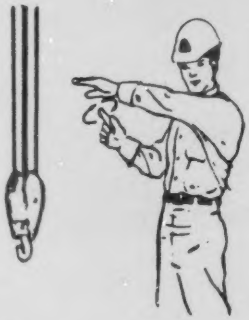


1. ________________ 2. ________________ 3. ________________

H. Hoist the load







1. ________________ 2. ________________ 3. ________________

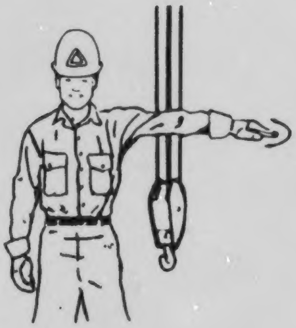
## ASSIGNMENT SHEET #1

Write an "X" in the correct blanks.

I. ______1. Stop

______2. Emergency stop

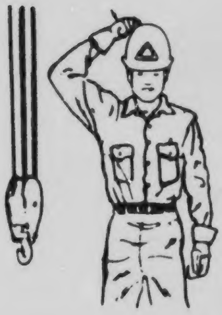
______3. Lower boom



J. ______1. Travel (both tracks)

______2. Use whipline

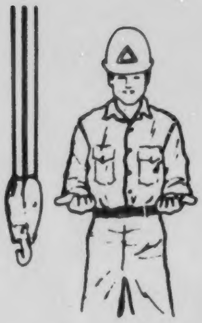
______3. Use main hoist



K. ______1. Move slowly

______2. Extend boom

______3. Raise the load

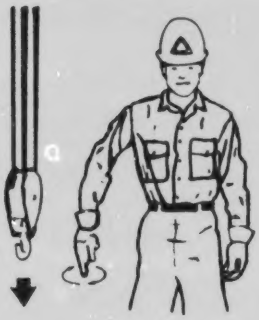


## ASSIGNMENT SHEET #1

L. ______1. Lower the load

______2. Emergency stop

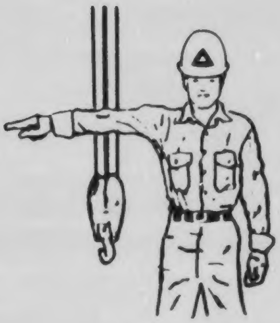
______3. Lower boom



M. ______1. Swing

______2. Travel (one track)

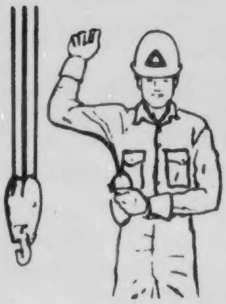
______3. Stop



N. ______1. Travel (both tracks)

______2. Dog everything

______3. Travel (one track)

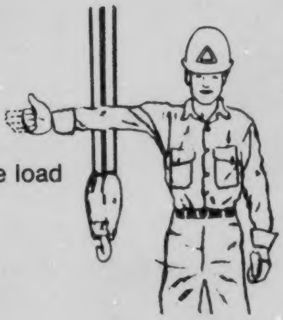


## ASSIGNMENT SHEET #1

O. ______1. Emergency stop

______2. Stop

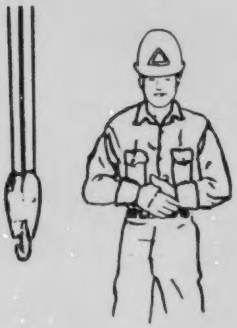
______3. Raise the boom and lower the load



P. ______1. Use main hoist

______2. Dog everything

______3. Use whipline



## MISCELLANEOUS EQUIPMENT
## UNIT III

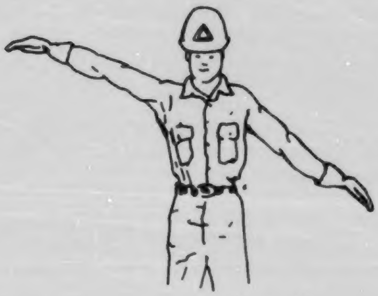
## ASSIGNMENT SHEET #2 — DISTINGUISH AMONG HAND SIGNALS USED IN FORKLIFT OPERATIONS

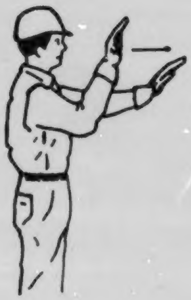
NAME ____________________________________________ SCORE __________________

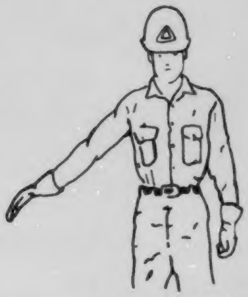
It is imperative to know hand signals before trying to give or receive them. Practice hand signals until you are proficient at giving and receiving them.

Distinguish among the following hand signals by writing an "X" in the blanks below the correct illustrations.

A. Tilt forks down

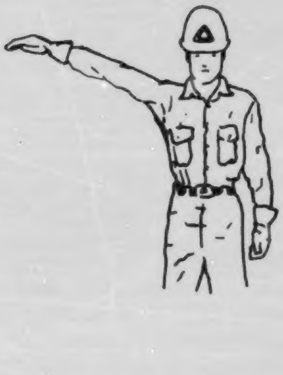


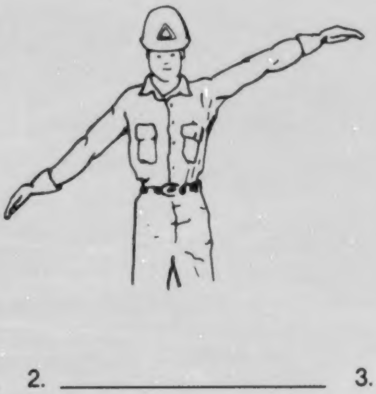


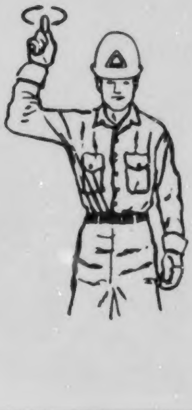


1. ____________________ 2. ____________________ 3. ____________________

B. Tilt forks left



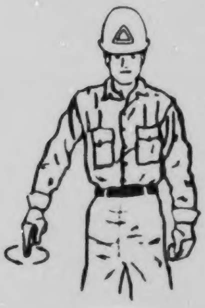


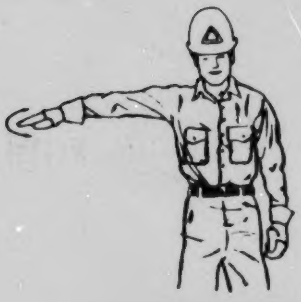


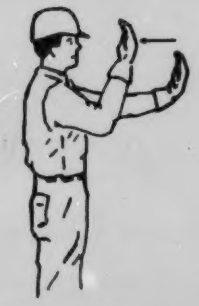
1. ____________________ 2. ____________________ 3. ____________________

## ASSIGNMENT SHEET #2

C. Lower load

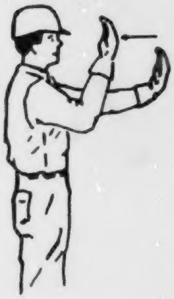


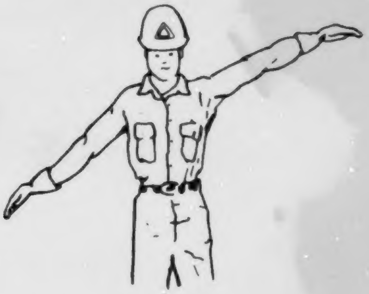


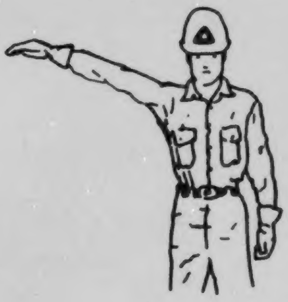


1. ____________________ 2. ____________________ 3. ____________________

D. Move load forward

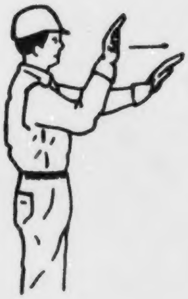


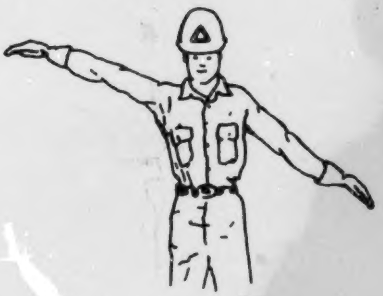


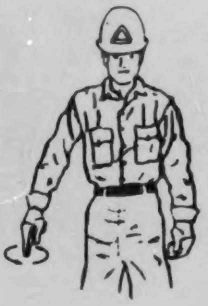


1. ____________________ 2. ____________________ 3. ____________________

E. Tilt forks right



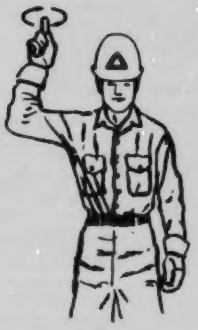


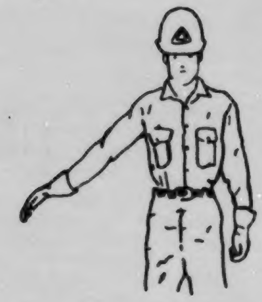


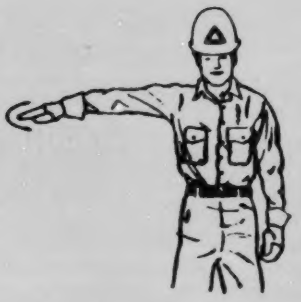
1. ____________________ 2. ____________________ 3. ____________________

## ASSIGNMENT SHEET #2

F. Raise load

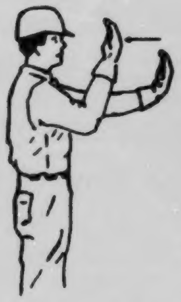


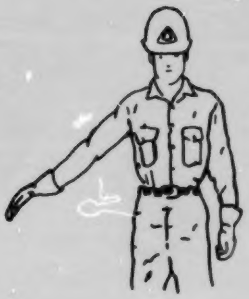


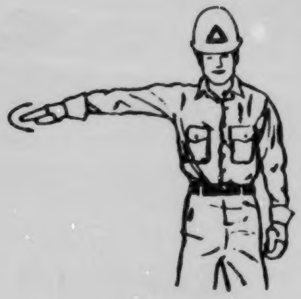


1. ______________________ 2. ______________________ 3. ______________________

G. Stop

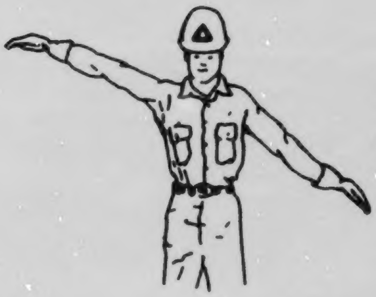


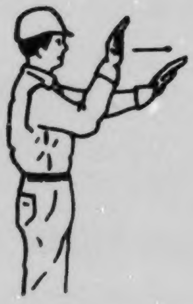


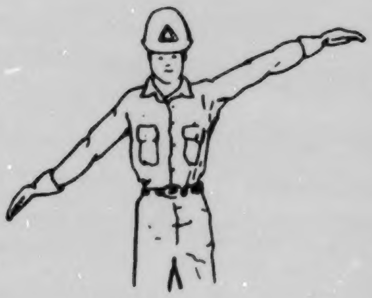


1. ______________________ 2. ______________________ 3. ______________________

H. Move load backward



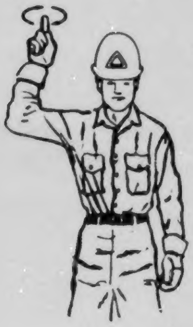


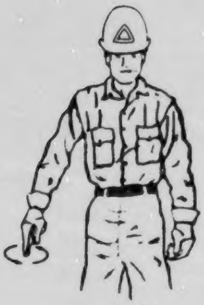


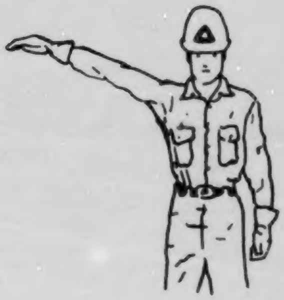
1. ______________________ 2. ______________________ 3. ______________________

## ASSIGNMENT SHEET #2

I. Tilt forks up







1. ____________________

2. ____________________

3. ____________________

## MISCELLANEOUS EQUIPMENT
## UNIT III

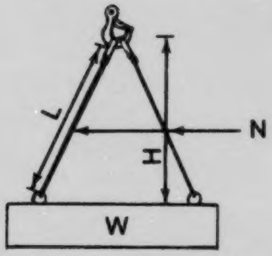
### ASSIGNMENT SHEET #3 — CALCULATE SLING STRESS

NAME ______________________________ SCORE ______________

The bricklayer should be proficient at accurately calculating sling stress. If sling stress is not calculated, or is calculated inaccurately, serious accidents and injury may occur, and materials may be wasted.

Calculate sling stress for the following illustrations.

EXAMPLE:

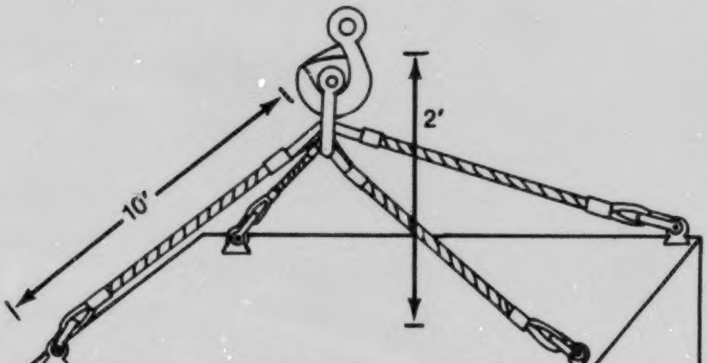


W = 10
L = 3′
H = 2′
N = 2

$$\frac{10 \times 3}{2 \times 2} = \frac{30}{4} = 7\ {}^{1}/_{2}$$

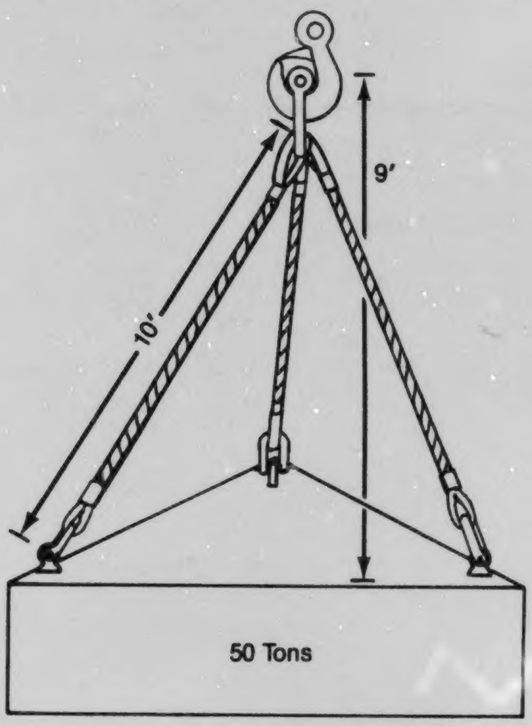
Stress = 7 ¹/₂ tons each sling

A. Sling stress = ______________



## ASSIGNMENT SHEET #3

B. Sling stress = ____________________



## MISCELLANEOUS EQUIPMENT
## UNIT III

## ANSWERS TO ASSIGNMENT SHEETS

### Assignment Sheet #1

| | |
|---|---|
| A. | 2 |
| B. | 3 |
| C. | 1 |
| D. | 1 |
| E. | 2 |
| F. | 3 |
| G. | 3 |
| H. | 1 |
| I. | 2 |
| J. | 3 |
| K. | 2 |
| L. | 1 |
| M. | 1 |
| N. | 3 |
| O. | 3 |
| P. | 2 |

### Assignment Sheet #2

| | |
|---|---|
| A. | 3 |
| B. | 2 |
| C. | 1 |
| D. | 1 |
| E. | 2 |
| F. | 1 |
| G. | 3 |
| H. | 2 |
| I. | 3 |

### Assignment Sheet #3

A. 125 tons each sling

B. 18 1/2 tons each sling

## MISCELLANEOUS EQUIPMENT
## UNIT III

## TEST

NAME ________________________________ SCORE ______________

1. Match to their correct definitions terms associated with miscellaneous equipment. Write the correct numbers in the blanks.

_____a. Engine-powered vehicle used to move materials

_____b. Portable trough for carrying mortar or masonry units; fixed crosswise on top of a pole and carried on the shoulder

_____c. Continuous chain or belt that moves material from one location to another, usually from ground level to an upper floor level

_____d. Single-load line

_____e. Elevator-type machine used for lifting material from low to high elevations

_____f. Wheeled container designed to hold mortar; can be moved freely from mixer to work site, eliminating wheelbarrows and mortar boxes

_____g. Temporary structure or platform used to support workers and materials at each staging height during construction

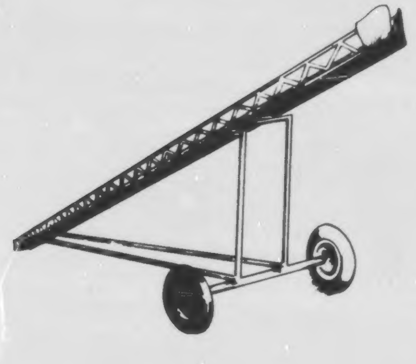
_____h. Normally every 5 feet of vertical construction

1. Conveyor
2. Whipline
3. Power buggy
4. Material hoist
5. Mortar hod
6. Scaffold
7. Staging height
8. Mortar tub

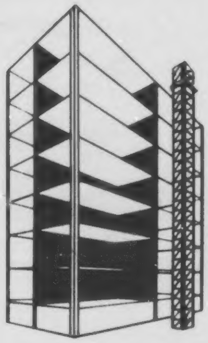
## TEST

2. Identify the following miscellaneous equipment related to bricklaying. Write the correct names in the blanks.

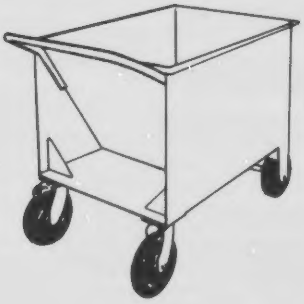
**Forklift**
**Conveyor**
**Mortar hod**
**Tower crane**
**Power buggy**
**Mortar tub**
**Crawler crane**
**Well wheel and boom**
**Material hoist**
**Masonry splitter**
**Hoist fork**
**Hoist bucket**



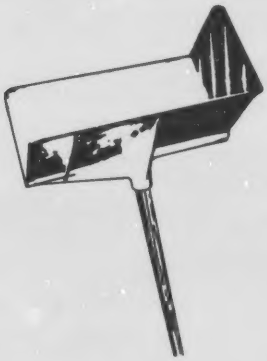
a. ______________________________



b. ______________________________

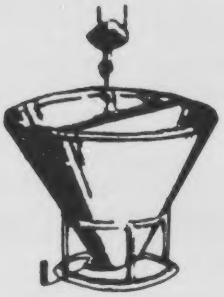


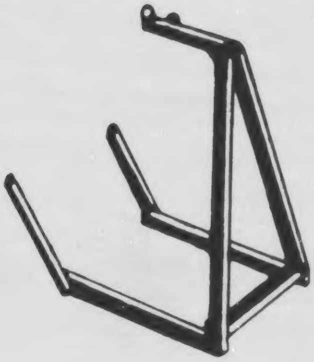
c. ______________________________



d. ______________________________

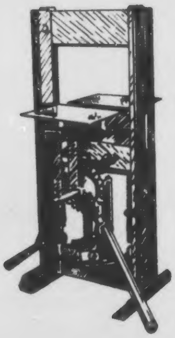
## TEST

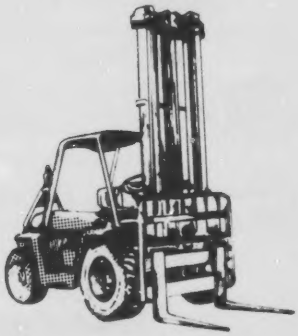




e. ______________________________

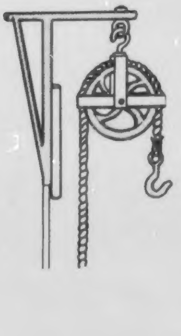
f. ______________________________

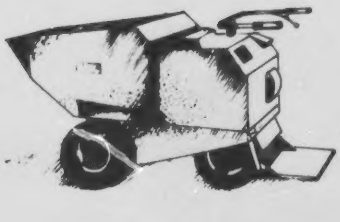




g. ______________________________

h. ______________________________

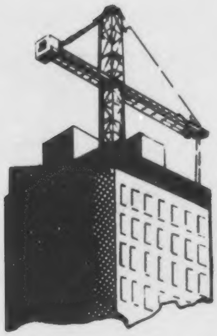


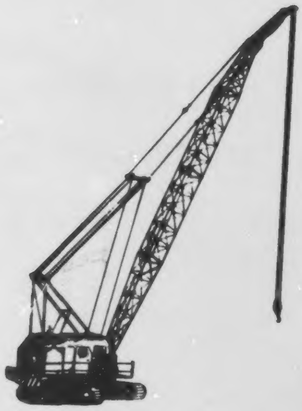


i. ______________________________

j. ______________________________

## TEST

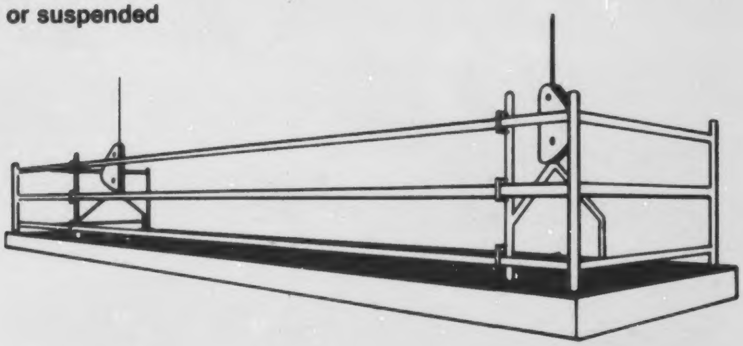




k. ______________________ l. ______________________

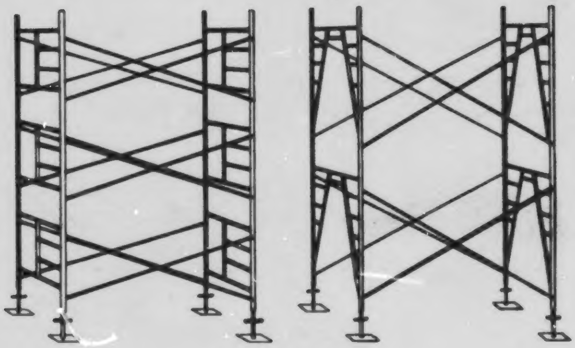
3. Identify the following types of scaffolds. Write the correct names in the blanks.

**Stationary steel sectional**
**Swing stage or suspended**
**Adjustable**

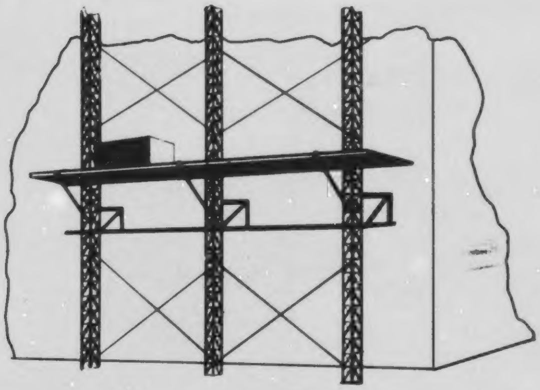


a. ______________________

# TEST



b. ______________________________



c. ______________________________

4. Name five safety rules pertaining to scaffolds.

a. ______________________________

b. ______________________________

c. ______________________________

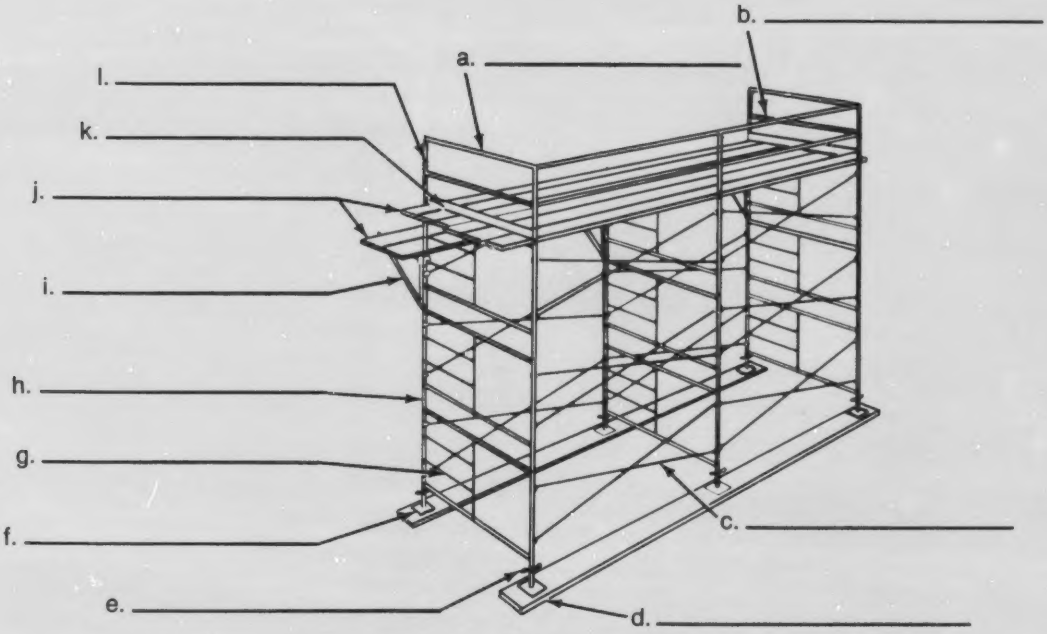
d. ______________________________

e. ______________________________

## TEST

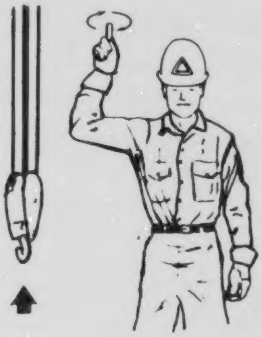
5. Identify the parts of the following stationary scaffold. Write the correct names in the blanks.

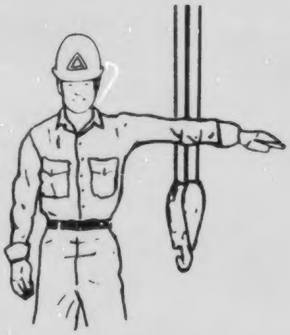
**Adjustable extension leg**
**Guardrail support**
**Scaffold boards**
**Base plate**
**Sill**
**Ladder**
**Side wall bracket**
**Toe board**
**Scaffold frame**
**Mid guardrail**
**Top guardrail**
**Diagonal brace**

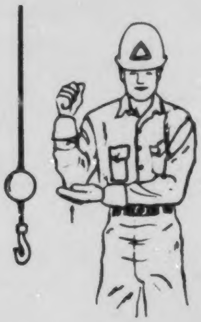


## TEST

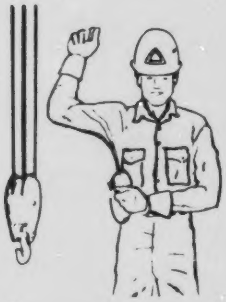
6. Label the following hand signals used in moving equipment and materials. Write the correct names in the blanks.

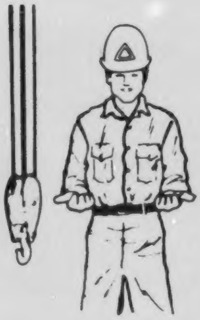


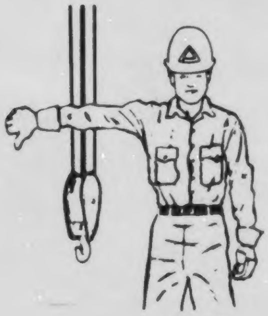




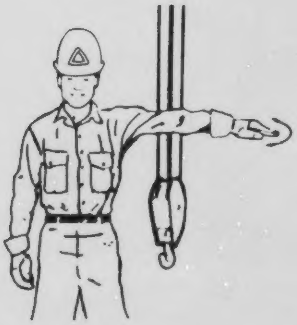
a. ______________________ b. ______________________ c. ______________________

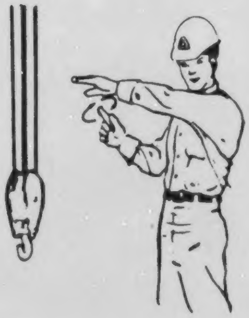


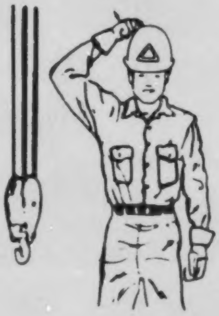




d. ______________________ e. ______________________ f. ______________________

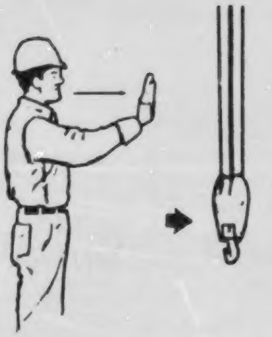




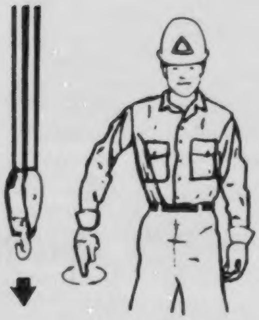


g. ______________________ h. ______________________ i. ______________________

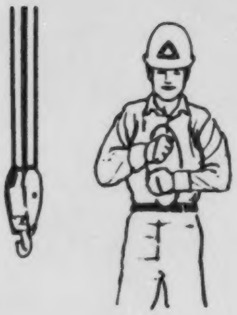
# TEST



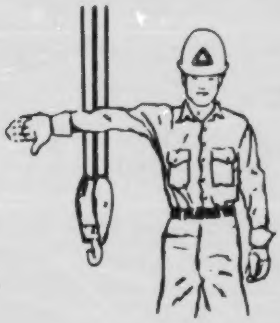
j. ______________________



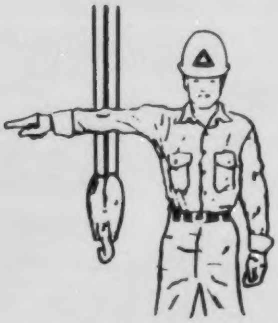
k. ______________________



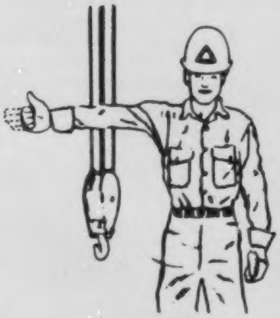
l. ______________________



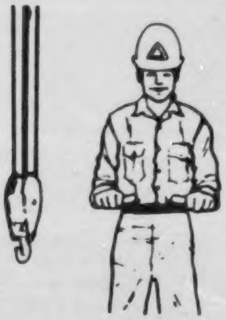
m. ______________________



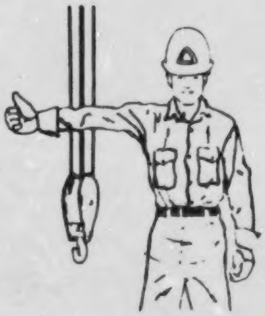
n. ______________________



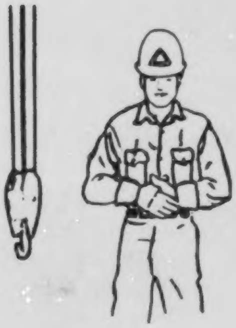
o. ______________________



p. ______________________



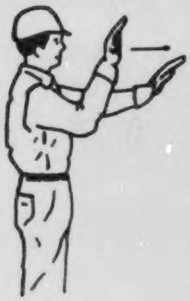
q. ______________________

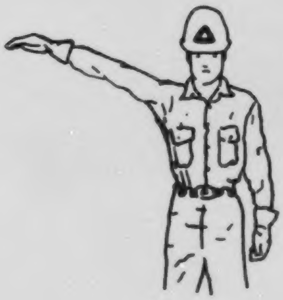


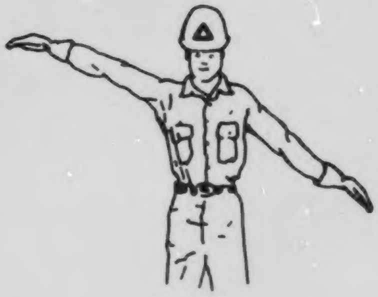
r. ______________________

# TEST

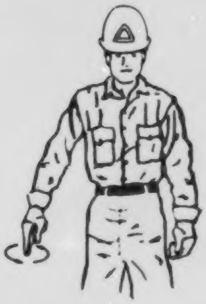
7. Label the following hand signals used in forklift operations. Write the correct names in the blanks.

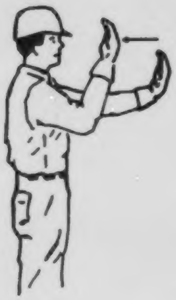


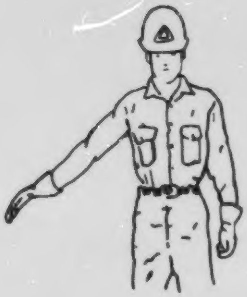




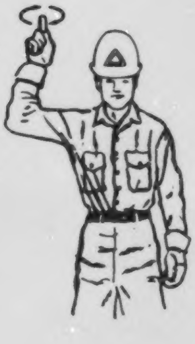
a. ____________________ b. ____________________ c. ____________________

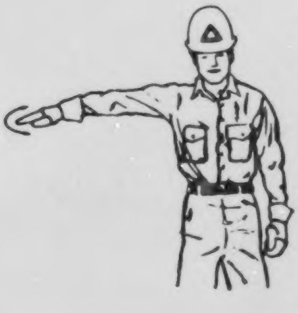


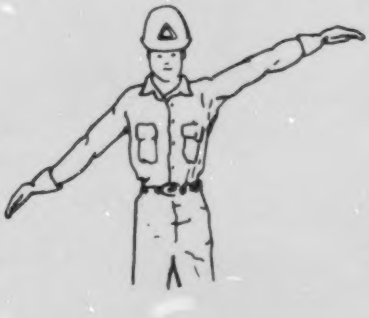




d. ____________________ e. ____________________ f. ____________________



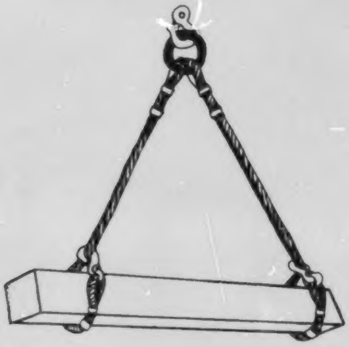




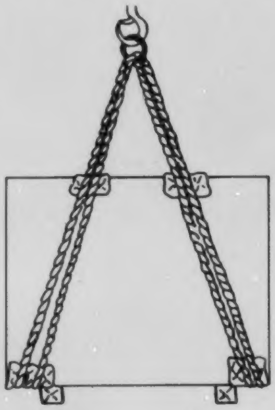
g. ____________________ h. ____________________ i. ____________________

# TEST

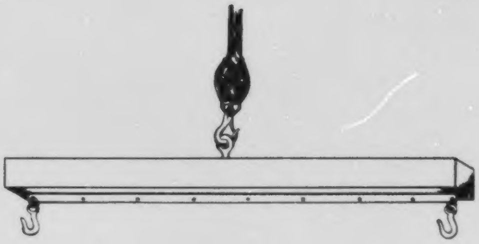
8. Label the following devices and types of rigging used to handle panels. Write the correct names in the blanks.



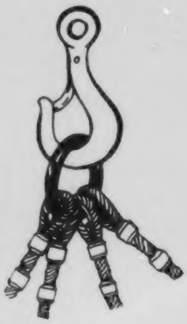
a. ____________________



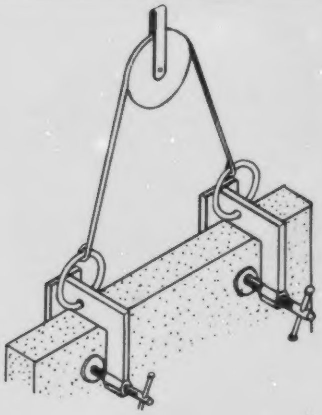
b. ____________________



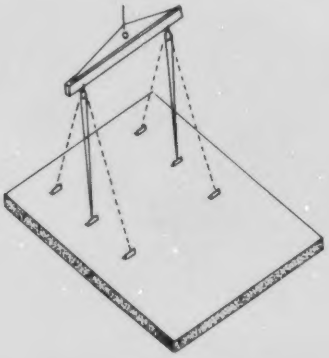
c. ____________________



d. ____________________

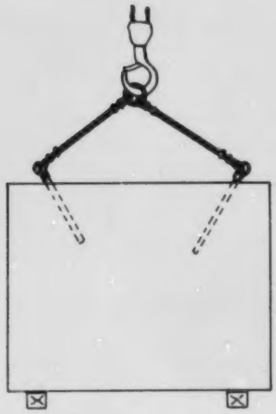


e. ____________________

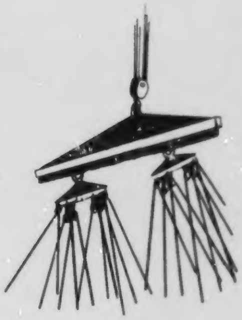


f. ____________________

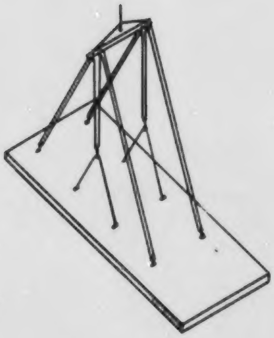
TEST



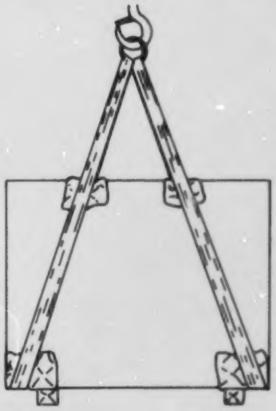
g. ______________________________



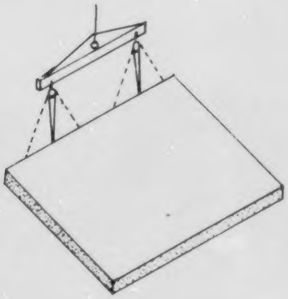
h. ______________________________



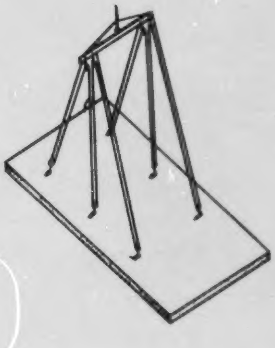
i. ______________________________



j. ______________________________

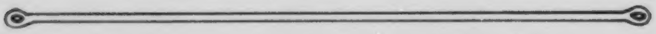


k. ______________________________



l. ______________________________

TEST



m. ______________________________

9. State the importance of spreading sling angles.

a. ____________________________________________________________

____________________________________________________________

b. ____________________________________________________________

____________________________________________________________

c. ____________________________________________________________

____________________________________________________________

d. ____________________________________________________________

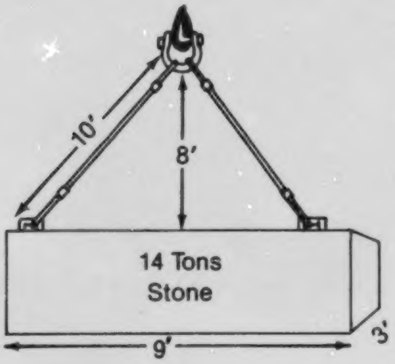
____________________________________________________________

e. ____________________________________________________________

____________________________________________________________

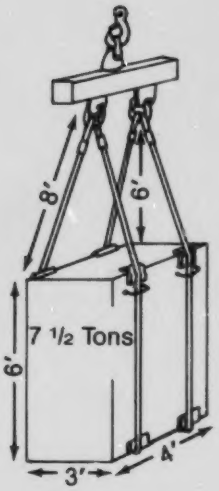
10. Calculate sling stress for the loads in the following illustrations.

a. Stress = ____________________


10′
8′
14 Tons
Stone
9′
3′

## TEST

b. Stress = ______________________



11. Select from the following list good rigging practices. Write an "X" in the blank before each correct answer.

______a. Pad all sharp corners and edges
______b. Use tagline to pull loads
______c. Wrap rope around hook when not in use
______d. Center crane over load before lifting
______e. Give all hand signals clearly and correctly
______f. Secure all unused sling lines
______g. Turn hooks to face hoist
______h. Never allow a shackle to be pulled at an angle
______i. Unhook load as soon as it is low enough to reach
______j. Use a shackle whenever two or more ropes are to be used over a hook
______k. Use shackles on chokers where there may be cutting action
______l. Never make vertical lifts on eye bolts
______m. Use thimble in eye splices.

# TEST

______n. Do not permit bending of rope near a splice or attached fitting

______o. Use screw pin shackle if the pin can roll under load and unscrew

______p. Keep machines at least 5 feet from all electrical equipment

______q. For proper sling angle, be sure that length of slings is always greater than span between the two connections

# MISCELLANEOUS EQUIPMENT
## UNIT III

## ANSWERS TO TEST

1. a. 3
   b. 5
   c. 1
   d. 2
   e. 4
   f. 8
   g. 6
   h. 7

2. a. Conveyor
   b. Material hoist
   c. Mortar tub
   d. Mortar hod
   e. Hoist bucket
   f. Hoist fork
   g. Masonry splitter
   h. Forklift
   i. Well wheel and boom
   j. Power buggy
   k. Tower crane
   l. Crawler crane

3. a. Swing stage or suspended
   b. Stationary steel sectional
   c. Adjustable

4. Answer should include any five of the following
   a. Maintain OSHA regulations
   b. Inspect scaffolds regularly
   c. Keep scaffolds plumb and level
   d. Install all braces and accessories according to manufacturer's recommendation
   e. Install anchors and guy wires on free-standing scaffolds
   f. Do not overload scaffolds
   g. Wear proper safety belt or harness when working on scaffolds
   h. Be sure that all safety rails are installed

## ANSWERS TO TEST

5. a. Top guardrail
   b. Mid guardrail
   c. Diagonal brace
   d. Sill
   e. Adjustable extension leg
   f. Base plate
   g. Ladder
   h. Scaffold frame
   i. Side wall bracket
   j. Scaffold boards
   k. Toe board
   l. Guardrail support

6. a. Hoist the load
   b. Stop
   c. Use whipline
   d. Travel (one track)
   e. Extend boom
   f. Lower boom
   g. Emergency stop
   h. Move slowly
   i. Use main hoist
   j. Travel
   k. Lower the load
   l. Travel (both tracks)
   m. Lower boom and raise load
   n. Swing
   o. Raise boom and lower load
   p. Retract boom
   q. Raise boom
   r. Dog everything

## ANSWERS TO TEST

7. a. Move load backward
   b. Tilt forks up
   c. Tilt forks right
   d. Lower load
   e. Move load forward
   f. Tilt forks down
   g. Raise load
   h. Stop
   i. Tilt forks left

8. a. Bridle
   b. Chokers or slings
   c. Spreader bar
   d. Bridle
   e. Stone clamps
   f. Basic two-point lift
   g. Lewis pins and bridle
   h. Spreader bar
   i. High rigging with approximately equal loads
   j. Straps or web slings
   k. Basic edge lift
   l. High rigging modified for panels of various widths
   m. Spreader

9. a. Changing angle of sling leg may increase stress on sling
   b. As angle is reduced, lifting capacity is reduced very rapidly

## ANSWERS TO TEST

c. When single leg of sling is at 60-degree angle, lifting capacity is only 87 percent of that of a vertical leg

d. When single leg of sling is at 45-degree angle, lifting capacity is only 71 percent of that of a vertical leg

e. When single leg of sling is at 30-degree angle, lifting capacity is only 50 percent of that of a vertical leg

10. a. $8\frac{3}{4}$ tons

b. $2\frac{1}{2}$ tons

11. a, d, e, f, h, j, k, m, n, q

# BUILDER'S LEVEL
## UNIT IV

## UNIT OBJECTIVE

After completing this unit, the student should be able to identify different types of levels, label parts of a builder's level, set up and adjust a level, and perform leveling jobs. The student will show this knowledge by completing assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with builder's levels to their correct definitions.
2. Label types of levels.
3. Describe types of self-reading rods.
4. Label the parts of a builder's level.
5. Label vertical and horizontal cross hairs and line of sight on a builder's level.
6. Label the parts of a leveling rod.
7. Match parts of a leveling rod to their correct uses.
8. State rules pertaining to care of leveling instruments.
9. Identify hand motions used by the instrument person to guide the rod person.
10. Read a self-reading rod (positive reading).
11. Demonstrate the ability to
    a. Set up and adjust a builder's level.
    b. Perform a differential leveling job by setting elevations for conveyor footings.

## BUILDER'S LEVEL
## UNIT IV

## SUGGESTED ACTIVITIES

I. Suggested activities

- A. Obtain transparencies.

  (NOTE: Transparencies are available from AGC and CIMC.)

- B. Gather equipment and materials for job sheet demonstrations.
- C. Provide students with objective sheet.
- D. Discuss unit and specific objectives.
- E. Provide students with information, assignment, and job sheets.
- F. Discuss information and assignment sheets.
- G. Invite local surveyor or professional instrument person to demonstrate use of builder's level.
- H. Demonstrate and discuss procedures outlined in job sheets.
- I. Provide different leveling jobs for students.
- J. Give test.
- K. Complete appropriate section of competency profiles.

  (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

- A. Objective sheet
- B. Suggested activities
- C. Information sheet
- D. Transparency masters
  - 1. TM #1 — Types of Levels
  - 2. TM #2 — Types of Levels (Continued)
  - 3. TM #3 — Self-Reading Rods

## SUGGESTED ACTIVITIES

   4. TM #4 — Parts of a Builder's Level
   5. TM #5 — Parts of a Leveling Rod
   6. TM #6 — Reading a Rod (Positive Reading Rod)

E. Assignment Sheet #1 — Read a Self-Reading Rod (Positive Reading)

F. Answers to assignment sheet

G. Job sheets

   1. Job Sheet #1 — Set Up and Adjust a Builder's Level
   2. Job Sheet #2 — Perform a Differential Leveling Job by Setting Elevations for Conveyor Footings

H. Test

I. Answers to test

III. Unit reference — Hendrix, Laborn J., "Bud." *Millwright Instructional Materials.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1980.

# BUILDER'S LEVEL
## UNIT IV

## INFORMATION SHEET

I. Terms and definitions

A. Builder's level — Leveling instrument consisting of a telescope, leveling bubble, and tripod; used primarily for establishing grade levels

B. Bench mark (BM) — Permanent point of known or assumed elevation

(NOTE: A specific point on a curb or culvert is sometimes used.)

C. Cross hairs — Fine horizontal and vertical lines in telescope barrel of leveling instrument; used as a reference line in the field or for marking instrumental axis

D. Differential leveling — Method of leveling by which the difference in elevation between two points is determined by plus and minus rod readings that are totaled and adjusted to bench mark

E. Elevation — Given grade

F. Fall — Slope of a line; usually given in inches per foot

EXAMPLE: One-inch fall per 1 foot of run

G. Finish floor height — Elevation of finished floor in relation to bench mark

H. Four-foot masonry reference mark — Reference mark used by bricklayer to indicate 4-foot intervals above bench mark

I. Grade line — Proposed or future level of ground at construction line

J. Grade stake — Stake driven into ground; locates proposed grade

(NOTE: The grade stake is read from the bench mark.)

K. Height of instrument (HI) — Vertical distance from bench mark to line of sight of leveling instrument

L. Laser-beam instrument — Automatic leveling instrument that uses a laser beam to establish elevation readings

M. Leveling rod — Rod used in leveling with builder's level; usually graduated in tenths and hundredths of a foot

N. Line of sight — Level line through leveling instrument as viewed by the eye; place where vertical hair crosses horizontal hair

## INFORMATION SHEET

O. Plumb bob — Tool or device attached to a string; used to set or check plumb or perpendicular of a surface

P. Self-reading rod — Scale on rod adjusted to height of leveling-instrument elevation and direct surface elevation; read by instrument person

Q. Site — Plot of ground on which a project is to be constructed

R. Surveying — Art or science of determining area and configuration of portions of earth's surface

S. Temporary bench mark (TBM) — Elevation reference point

II. Types of levels (Transparencies #1 and #2)

   A. Builder's

   B. Turret

   C. Engineer's dumpy

   D. Engineer's wild tilting

   E. Engineer's zeiss

   F. Laser-beam instrument

   G. Automatic

III. Types of self-reading rods (Transparency #3)

   A. Positive reading — Gives difference in elevation between HI and elevation of ground where shot is being taken

   B. Direct reading — Adjusts rod to true elevation; any reading taken through instrument at this point is automatically the true elevation

IV. Parts of a builder's level (Transparency #4)

   A. Eyepiece

   B. Telescope barrel

   C. Focusing screw

   D. Sunshade

   E. Bubble tube

## INFORMATION SHEET

F. Leveling head

G. Leveling screw

H. Head plate

I. Tripod

J. Leg thumb nut

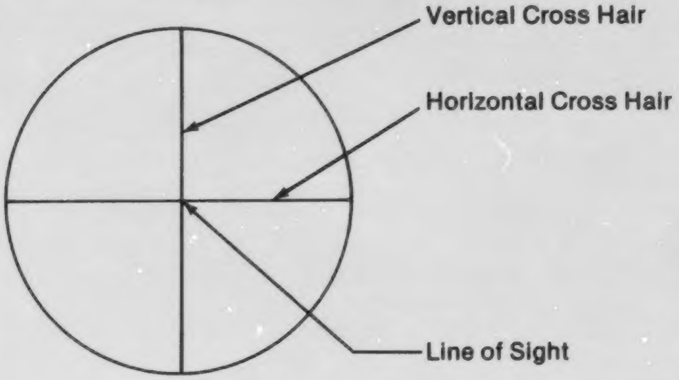
K. Slow-motion screw

L. Clamp

V. Vertical and horizontal cross hairs and line of sight on a builder's level (Figure 1)

(NOTE: Vertical cross hairs indicate the direction. Horizontal cross hairs indicate the flat plane. Line of sight is indicated at the cross of the vertical and horizontal.)

FIGURE 1



VI. Parts of a leveling rod (Transparency #5)

A. Target face

B. Target clamp

C. Rod clamp

D. Vernier scale

VII. Correct uses for parts of a leveling rod

A. Target face — Red and white disk on rod used for certain types of readings

B. Target clamp — Holds target in place

## INFORMATION SHEET

C. Rod clamp — Holds rod when extended

D. Vernier scale — Found on target face and rod clamp; enables reading to the nearest thousandth of a foot

VIII. Rules pertaining to care of leveling instruments

(NOTE: Leveling instruments are very sensitive and must be used and cared for very delicately.)

A. Protect against shock and vibration when transporting

B. Keep in case except when in use

C. Place lens and tripod caps in box after removing from leveling instrument

D. Attach leveling instrument to tripod carefully and firmly before moving tripod

E. Never force screws or other moving parts of a leveling instrument

F. Always use sunshade regardless of weather

G. Clean lenses with soft tissue

H. Do not clean lenses with fingers

I. Do not remove lenses

J. Loosen setscrews when leveling instrument is not in use

IX. Hand motions used by the instrument person to guide the rod person (Figures 2-11)

A. Move in this direction

FIGURE 2

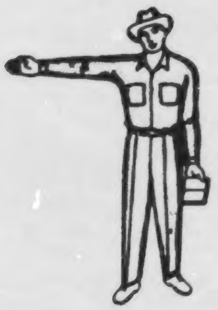
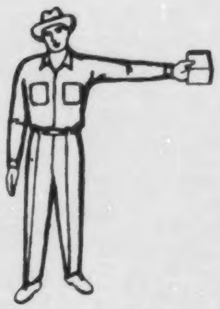


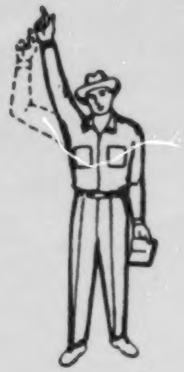
FIGURE 3



## INFORMATION SHEET

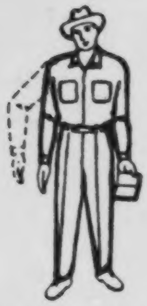
B. Move up

FIGURE 4



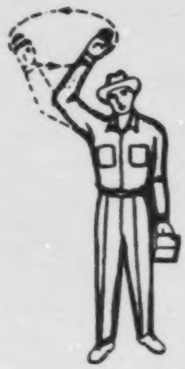
C. Move down

FIGURE 5



D. Turning point

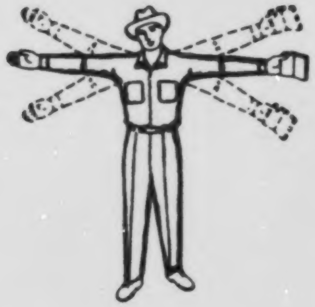
FIGURE 6



## INFORMATION SHEET

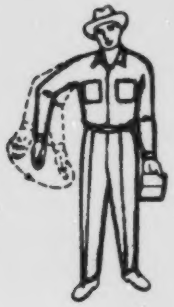
E. Observation completed; move on; understand

FIGURE 7



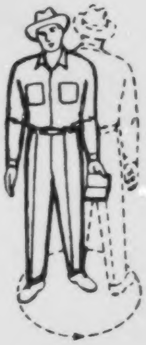
F. Come in

FIGURE 8



G. Wrong face; check clamp; rod upside down

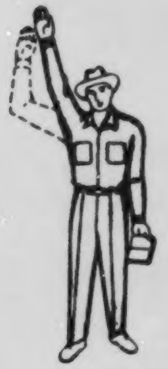
FIGURE 9



## INFORMATION SHEET

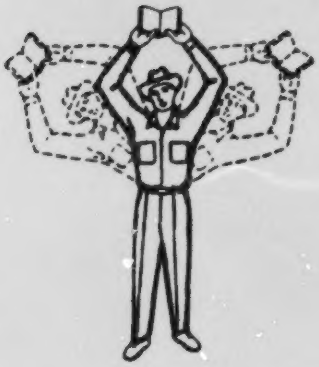
H. Use long rod

FIGURE 10



I. Wave rod from side to side

FIGURE 11



X. Reading the self-reading rod (positive reading) (Transparency #6; Assignment Sheet #1)

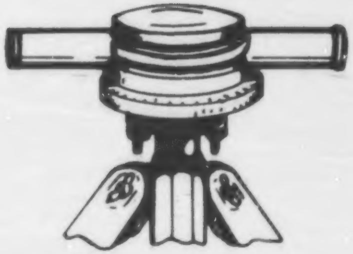
A. Large red numbers indicate full feet

B. Smaller black numbers indicate tenths of feet (0.1 feet)

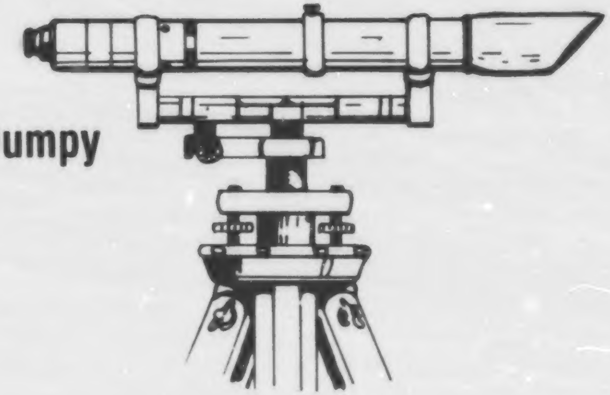
C. Top and bottom of small black marks indicate hundredths of feet (0.01 feet)

D. Vernier scale reads in thousandths of feet (0.001 feet)

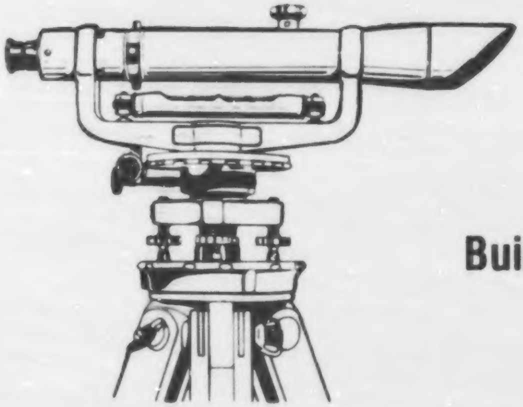
# Types of Levels



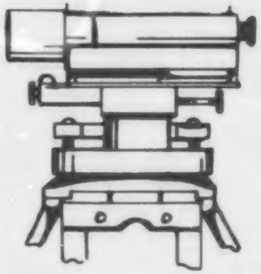
Turret



Engineer's Dumpy



Builder's

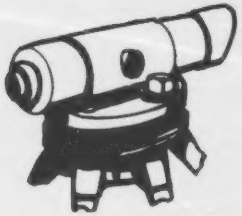


Engineer's Wild Tilting

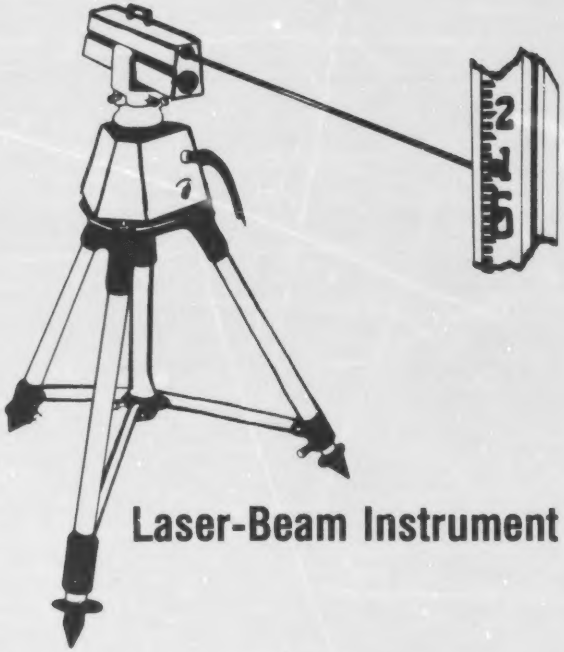
TM #1

PBL - 169-A

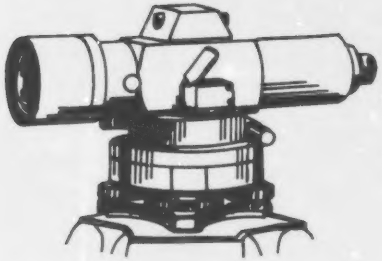
# Types of Levels
## (Continued)



Engineer's Zeiss



Laser-Beam Instrument



Automatic

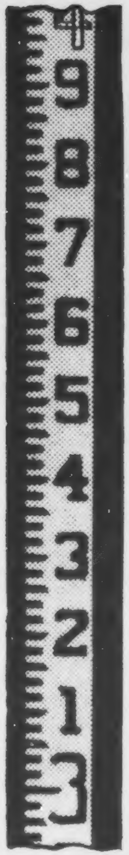
TM #2

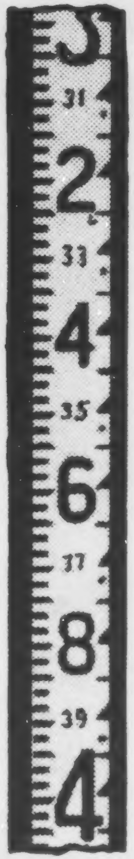
PBL - 171-A

# Self-Reading Rods

Positive
↑
Reading

Philadelphia
or
''Philly'' Rod


4
9
8
7
6
5
4
3
2
1
3


3
31
2
33
4
35
6
37
8
39
4

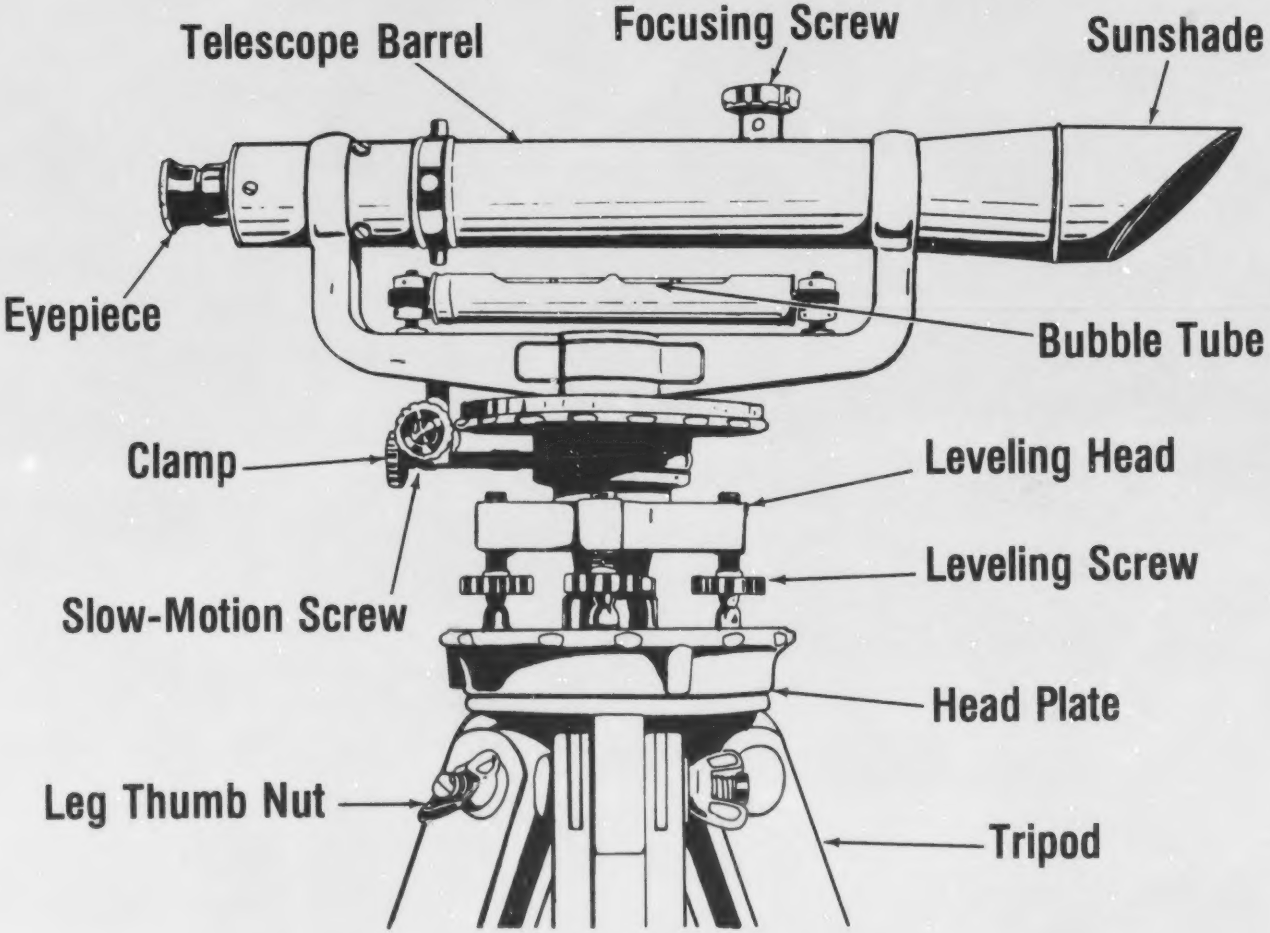
Direct
↓
Reading

Elevation
or
''Linker'' Rod

TM #3

PBL - 173-A

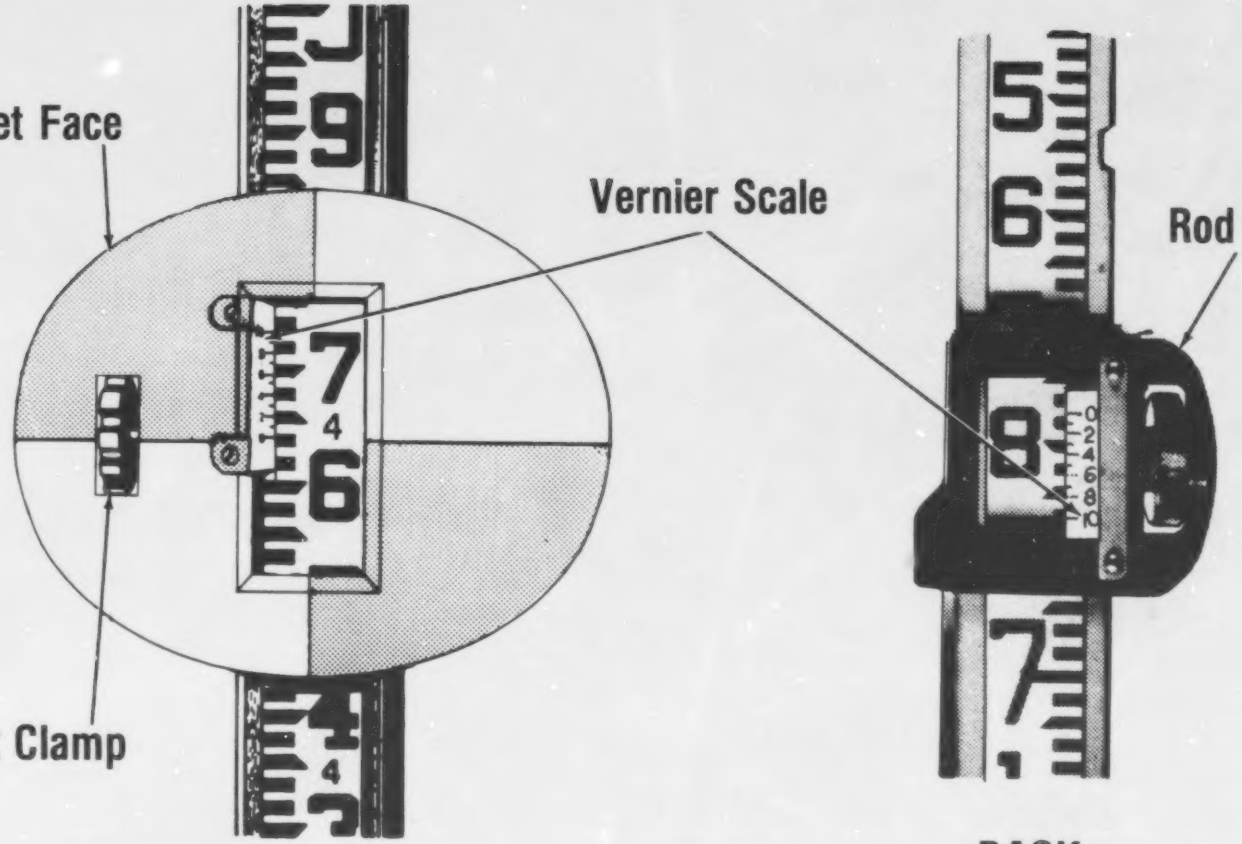
# Parts of a Builder's Level


Telescope Barrel
Focusing Screw
Sunshade
Eyepiece
Bubble Tube
Clamp
Leveling Head
Leveling Screw
Slow-Motion Screw
Head Plate
Leg Thumb Nut
Tripod

TM #4

PBL - 175-A

# Parts of a Leveling Rod



Target Face

Vernier Scale

Rod Clamp

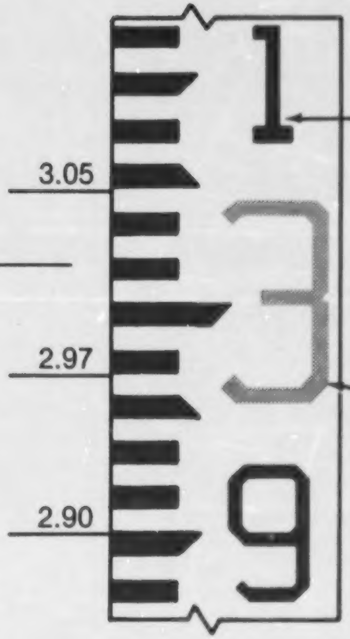
Target Clamp

FRONT

BACK

# Reading a Rod

## (Positive Reading Rod)



**Tenths of Feet (Black)**

**Hundredths of Feet (Black and White)**

**Full-Foot Numbers (Red)**

**Vernier scale reads thousandths of feet.**

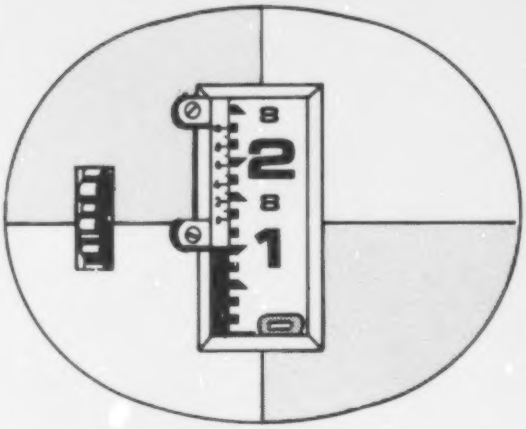
# BUILDER'S LEVEL
# UNIT IV

## ASSIGNMENT SHEET #1 — READ A SELF-READING ROD (POSITIVE READING)

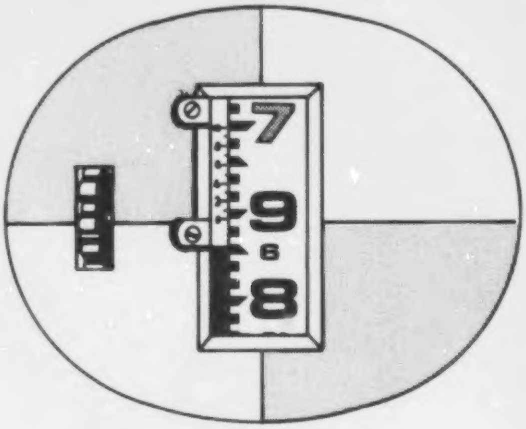
NAME ______________________________ SCORE ______________

The self-reading rod is one of the bricklayer's most important tools. With practice, the bricklayer can become skilled at reading elevations quickly and accurately while looking through the telescope of the builder's level.

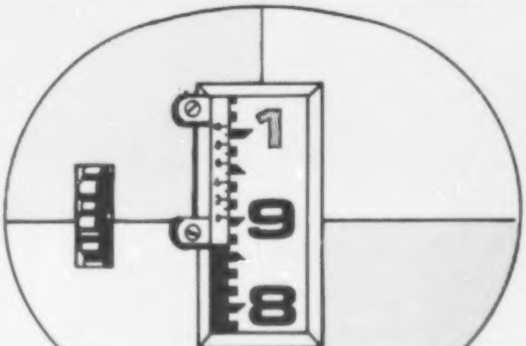
Read to the nearest hundredth each of the illustrations below. Record your results in the blanks provided.



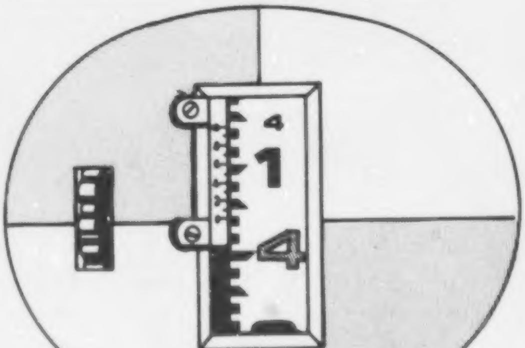
A. ______________________________



B. ______________________________



C. ______________________________



D. ______________________________

## BUILDER'S LEVEL
## UNIT IV

## ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

A. 8.13

B. 6.89

C. 0.90

D. 4.04

## BUILDER'S LEVEL
## UNIT IV

### JOB SHEET #1 — SET UP AND ADJUST A BUILDER'S LEVEL

I. Equipment

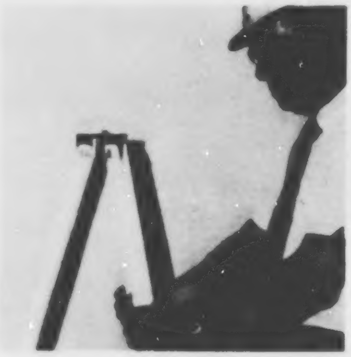
A. Builder's level

B. Tripod

II. Procedure

A. Grasp two tripod legs nearest you; set leg shoes in ground about 3 feet apart (Figure 12)

FIGURE 12



B. Swing third leg out to form a triangle

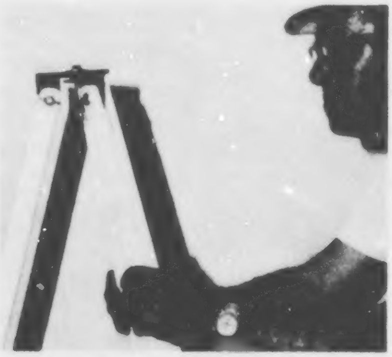
(NOTE: If the ground is not level, you may have to change position of tripod in order to keep head plate level. Always place two legs on downhill or unlevel side.)

C. Tighten leg thumb nuts

JOB SHEET #1

D. Check head plate to see that it is level (Figure 13)

FIGURE 13



E. Remove leveling instrument from carrying case by lifting the level bar (Figure 14)

**(CAUTION: Never grasp the telescope barrel while removing leveling instrument from carrying case.)**

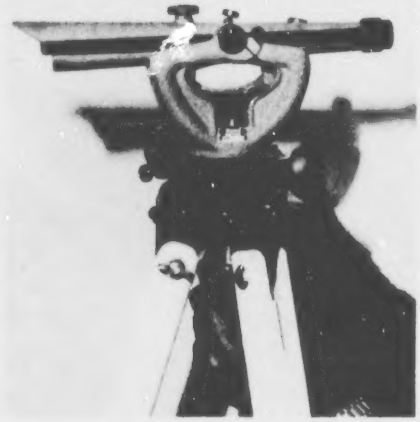
FIGURE 14

JOB SHEET #1

F. Screw leveling instrument to head plate (Figure 15)

**(CAUTION: Keep a firm grip on instrument until it is screwed securely to tripod.)**

FIGURE 15



G. Remove dust cap from front lens

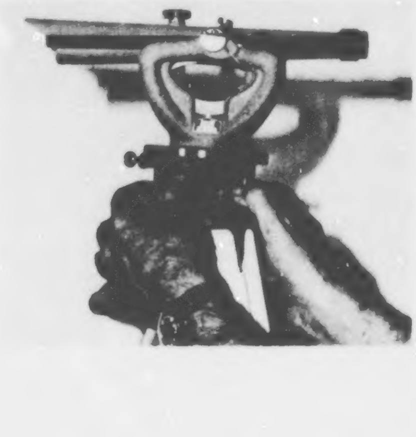
(NOTE: The dust cap protects the lens from dust or scratches.)

H. Attach sunshade to leveling instrument

I. Align telescope barrel directly over one pair of leveling screws (Figure 16)

(NOTE: The leveling screws are used to level the instrument.)

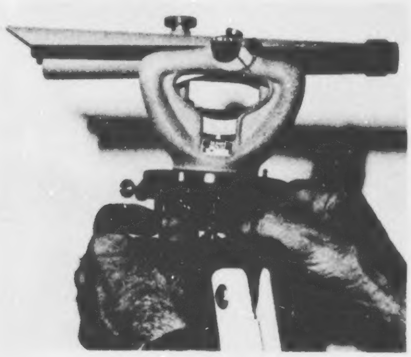
FIGURE 16



# JOB SHEET #1

J. Moving your thumbs in opposite directions, rotate screws under leveling head to bring bubble to center of leveling tube (Figure 17)

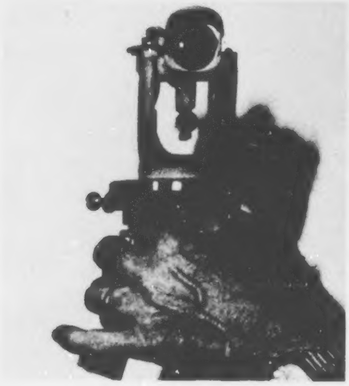
FIGURE 17



K. Check bubble to see that it is centered

L. Turn leveling instrument clockwise 90 degrees to align with other pair of leveling screws (Figure 18)

FIGURE 18



M. Bring bubble to center of marks by rotating leveling screws

N. Turn leveling instrument clockwise 90 degrees to bring it parallel with first pair of leveling screws

O. Center bubble again

P. Turn leveling instrument clockwise 90 degrees to bring it parallel with second pair of leveling screws

Q. Center bubble again

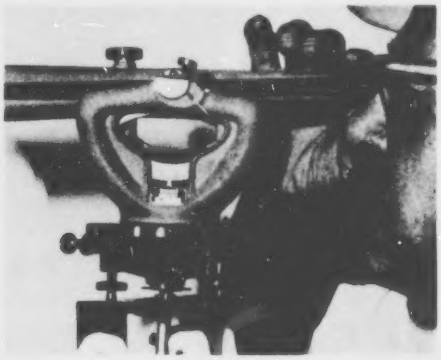
(NOTE: Bubble should stay in center regardless of what direction the telescope is pointing. If bubble does not stay in center, instrument is out of level and should be adjusted by competent personnel.)

## JOB SHEET #1

R. Focus cross hairs so that they appear sharp and clear (Figure 19)

(NOTE: Focusing is accomplished by looking through the eyepiece and turning eyepiece ring until the cross hairs become sharp or clear.)

FIGURE 19



S. Be sure that cross hairs are focused

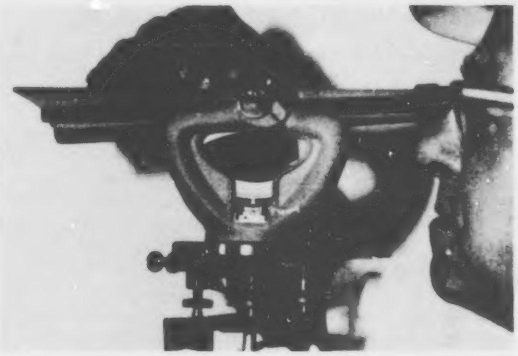
(NOTE: The target may not be in focus.)

T. Rotate focusing screw to bring target into sharp focus (Figure 20)

(NOTE: When cross hairs and target are in sharp focus, you should be able to read a rod accurately. Always tie level shots back to starting bench mark to check for error in rod shots or in field notes.)

**(CAUTION: After instrument is level, keep hands off tripod. Use the instrument only. If instrument creeps off level or is bumped, stop and reset tripod, relevel instrument, and start again from last known good bench mark.)**

FIGURE 20



U. Put away equipment

# BUILDER'S LEVEL
# UNIT IV

## JOB SHEET #2 — PERFORM A DIFFERENTIAL LEVELING JOB BY SETTING ELEVATIONS FOR CONVEYOR FOOTINGS

I. Equipment and materials

- A. Builder's level
- B. Leveling rod
- C. Tripod
- D. Field book or pad of paper
- E. Pencil

II. Procedure

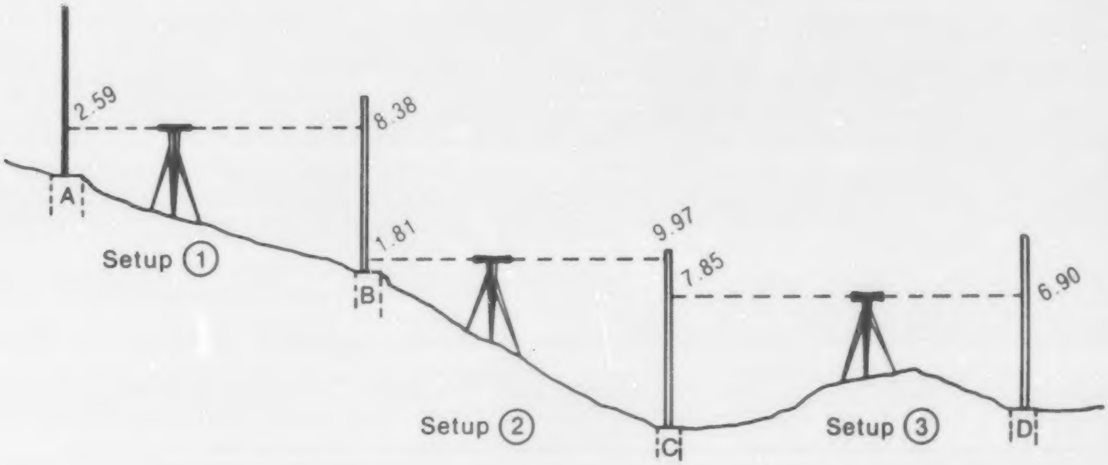
- A. Establish where to set builder's level, and determine difference in elevation between points A and D (See Figure 21.)

  (NOTE: Do not set up over 150 to 200 feet away from each point.)

- B. Set up builder's level
- C. Read leveling rod (Figure 21)

  (NOTE: The leveling rod is held by a co-worker.)

FIGURE 21



## JOB SHEET #2

1. Line of sight at A is 2.59 from setup one
2. Line of sight at B is 8.38 from setup one
3. Record these readings on pad (Figure 22)

   (NOTE: Plus sight is the rod reading from point to line of sight. Minus sight is the rod reading from line of sight to the point.)

FIGURE 22

| STATION | + Rod | H I | − Rod | Elevation |
|---|---|---|---|---|
| 1 | 2.59 | | | |
| | | | 8.38 | |
| | | | | |
| | | | | |
| | | | | |

D. Establish second setup for builder's level (See Figure 21.)

E. Set up builder's level

F. Read leveling rod

(NOTE: The leveling rod is held by a co-worker.)

1. Line of sight at B is 1.81 from setup two
2. Line of sight at C is 9.97 from setup two
3. Record these reading on pad (Figure 23)

FIGURE 23

| STATION | + Rod | H I | − Rod | Elevation |
|---|---|---|---|---|
| 1 | 2.59 | | | |
| | | | 8.38 | |
| 2 | 1.81 | | | |
| | | | 9.97 | |
| | | | | |

## JOB SHEET #2

G. Establish third setup for builder's level (See Figure 21.)

H. Set up builder's level

I. Read leveling rod

(NOTE: The leveling rod is held by co-worker.)

1. Line of sight at C is 7.85 from setup three
2. Line of sight at D is 6.90 from setup three
3. Record these readings on pad (Figure 24)

FIGURE 24

| STATION | $\overset{+}{\text{Rod}}$ | H I | $\overset{-}{\text{Rod}}$ | Elevation |
|---|---|---|---|---|
| 1 | 2.59 | | | |
| | | | 8.38 | |
| 2 | 1.81 | | | |
| | | | 9.97 | |
| 3 | 7.85 | | | |
| | | | 6.90 | |
| | | | | |
| Sum | 12.25 | | 25.25 | |

J. Total plus sight column and minus sight column

K. Subtract smaller number from larger to find the difference in elevations

(NOTE: Subtract 12.25 from 25.25. Point D is lower than point A by 13.00.)

L. Put away equipment and materials

# BUILDER'S LEVEL
## UNIT IV

## TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with builder's levels to their correct definitions. Write the correct numbers in the blanks. Terms and definitions continue on the following page.

______a. Permanent point of known or assumed elevation

______b. Proposed or future level of ground at construction line

______c. Plot of ground on which a project is to be constructed

______d. Given grade

______e. Slope of a line; usually given in inches per foot

______f. Scale on rod adjusted to height of leveling-instrument elevation and direct surface elevation; read by instrument person

______g. Rod used in leveling with builder's level; usually graduated in tenths and hundredths of a foot

______h. Vertical distance from bench mark to line of sight of leveling instrument

______i. Automatic leveling instrument that uses a laser beam to establish elevation readings

______j. Elevation of finished floor in relation to bench mark

______k. Level line through leveling instrument as viewed by the eye; place where vertical hair crosses horizontal hair

______l. Reference mark used by bricklayer to indicate 4-foot intervals above bench mark

1. Elevation
2. Leveling rod
3. Grade line
4. Line of sight
5. Finish floor height
6. Bench mark (BM)
7. Height of instrument (HI)
8. Self-reading rod
9. Fall
10. Four-foot masonry reference mark
11. Site
12. Laser-beam instrument

## TEST

_____m. Leveling instrument consisting of a telescope, leveling bubble, and tripod; used primarily for establishing grade levels

_____n. Art or science of determining area and configuration of portions of earth's surface

_____o. Tool or device attached to a string; used to set or check plumb or perpendicular of a surface

_____p. Elevation reference point

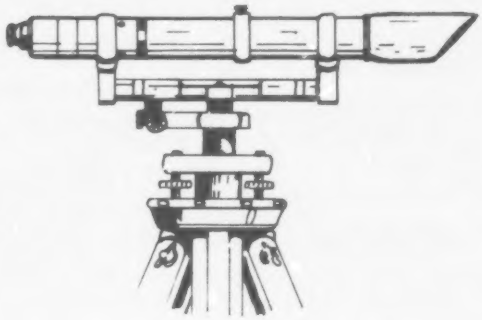
_____q. Stake driven into ground; locates proposed grade

_____r. Method of leveling by which the difference in elevation between two points is determined by plus and minus rod readings that are totaled and adjusted to bench mark

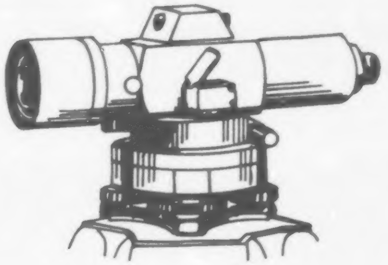
_____s. Fine horizontal and vertical lines in telescope barrel of leveling instrument; used as a reference line in the field or for marking instrumental axis

13. Builder's level
14. Differential leveling
15. Temporary bench mark (TBM)
16. Cross hairs
17. Plumb bob
18. Grade stake
19. Surveying

2. Label the following types of levels.

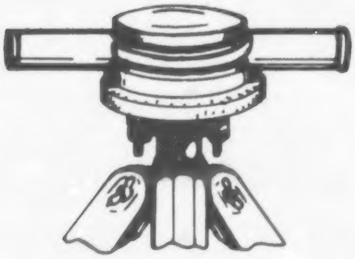


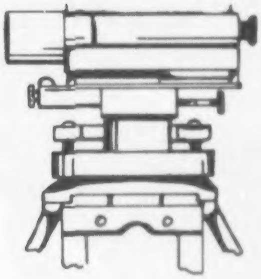
a. ______________________________



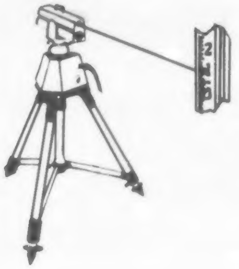
b. ______________________________

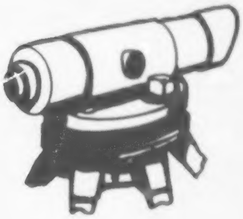
TEST



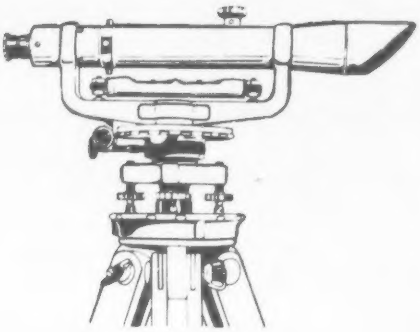


c. ______________________________ d. ______________________________





e. ______________________________ f. ______________________________



g. ______________________________

# TEST

3. Describe types of self-reading rods.

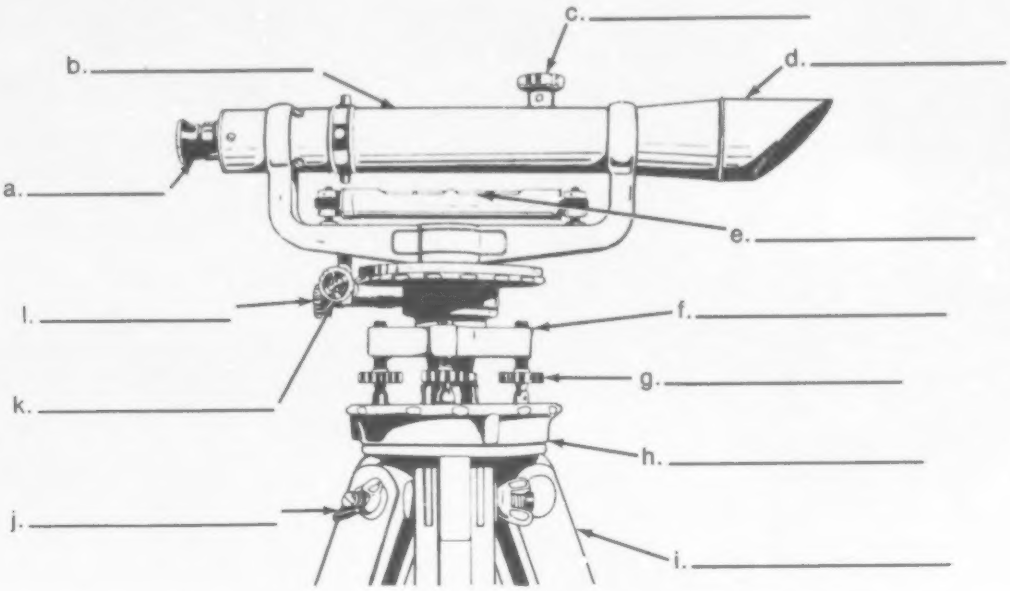
   a. Positive reading — ______________________________________________

   ______________________________________________

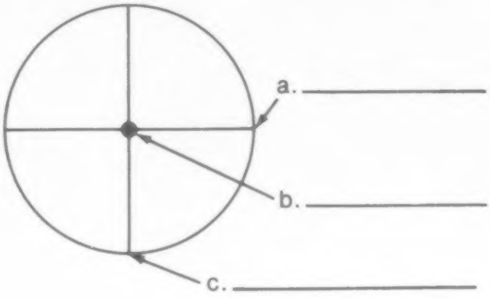
   b. Direct reading — ______________________________________________

   ______________________________________________

4. Label the parts of the builder's level illustrated below.

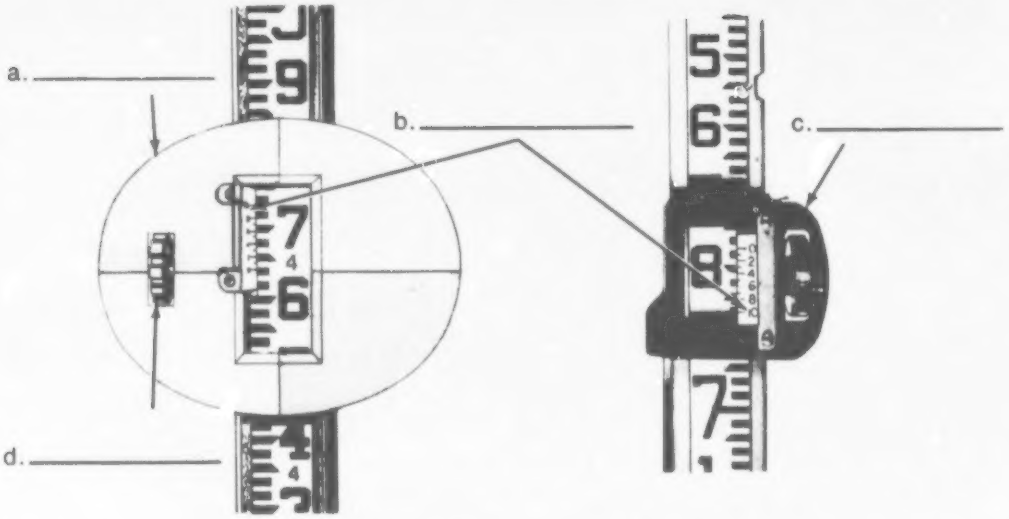


5. Label vertical and horizontal cross hairs and line of sight on the builder's level illustrated below.



## TEST

6. Label the parts of the leveling rod illustrated below.



7. Match parts of a leveling rod to their correct uses. Write the correct numbers in the blanks.

_____a. Holds target in place

_____b. Holds rod when extended

_____c. Red and white disk on rod used for certain types of readings

_____d. Found on target face and rod clamp; enables reading to the nearest thousandth of a foot

1. Target face
2. Target clamp
3. Vernier scale
4. Rod clamp

8. State five rules pertaining to care of leveling instruments.

a. ______________________________________________

b. ______________________________________________

c. ______________________________________________

d. ______________________________________________

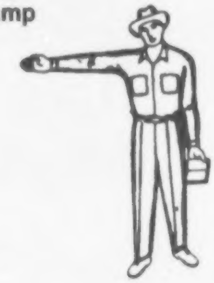
e. ______________________________________________

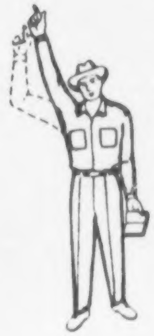
## TEST

9. Identify hand motions used by instrument person to guide the rod person. Write the correct names in the blanks. Some blanks may contain more than one answer. Some answers may be used more than once.

**Observation completed**
**Wave rod from side to side**
**Use long rod**
**Rod upside down**
**Move in this direction**
**Wrong face**
**Check clamp**

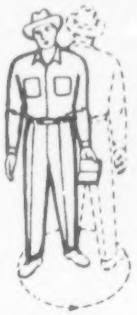
**Move up**
**Move down**
**Move on**
**Turning point**
**Understand**
**Come in**

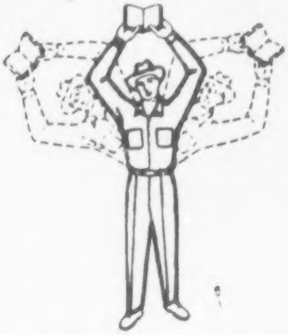




a. ____________________

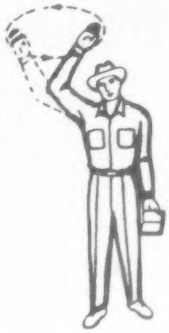
b. ____________________

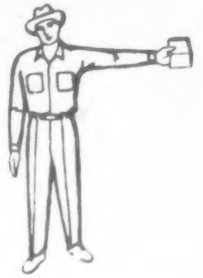




c. ____________________

d. ____________________

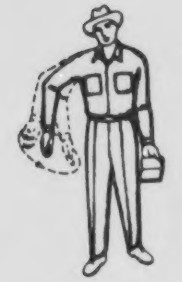


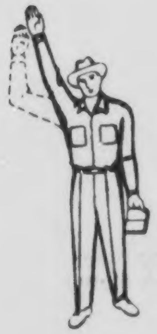


e. ____________________

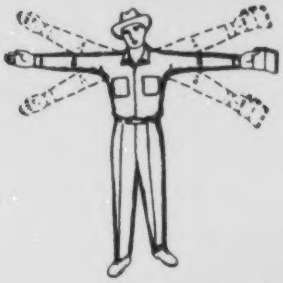
f. ____________________

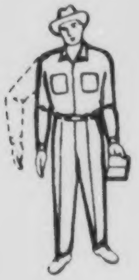
## TEST





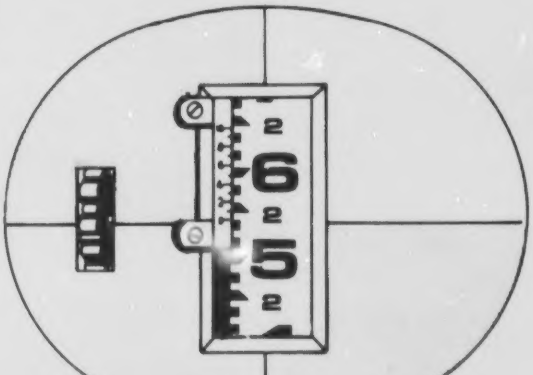
g. ______________________________ h. ______________________________

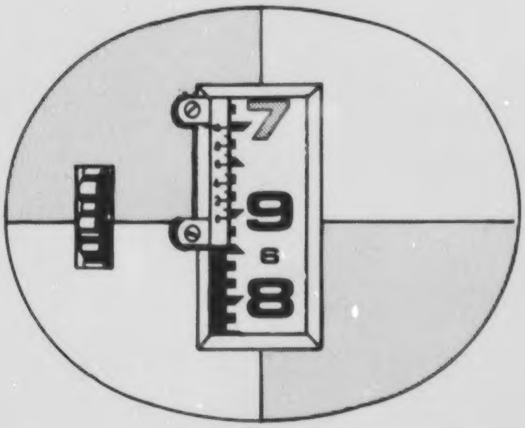




i. ______________________________ j. ______________________________

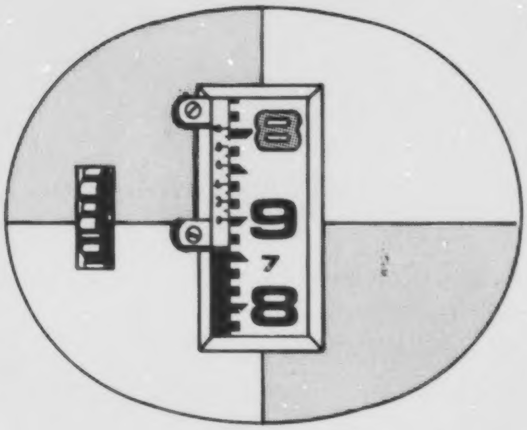
10. Read to the nearest hundredth each of the following rods. Write the correct answers in the blanks.

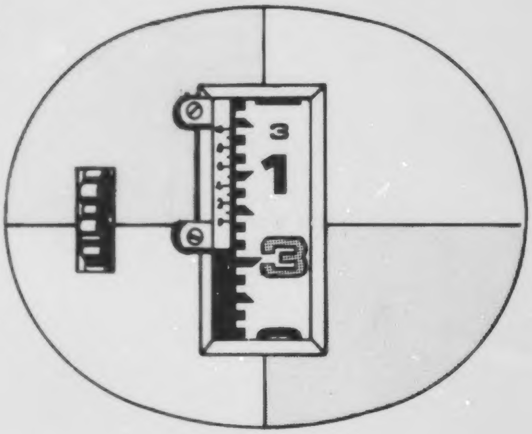




a. ______________________________ b. ______________________________

## TEST





c. ____________________ d. ____________________

(NOTE: Test question 11 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

11. Demonstrate the ability to

   a. Set up and adjust a builder's level.

   b. Perform a differential leveling job by setting elevations for conveyor footings.

# BUILDER'S LEVEL
# UNIT IV

## ANSWERS TO TEST

1. a. 6
   b. 3
   c. 11
   d. 1
   e. 9
   f. 8
   g. 2
   h. 7
   i. 12
   j. 5
   k. 4
   l. 10
   m. 13
   n. 19
   o. 17
   p. 15
   q. 18
   r. 14
   s. 16

2. a. Engineer's dumpy
   b. Automatic
   c. Turret
   d. Engineer's wild tilting
   e. Laser-beam instrument
   f. Engineer's zeiss
   g. Builder's

3. Description should include the following
   a. Positive reading — Gives difference in elevation between HI and elevation of ground where shot is being taken
   b. Direct reading — Adjusts rod to true elevation; any reading taken through instrument at this point is automatically the true elevation

4. a. Eyepiece
   b. Telescope barrel
   c. Focusing screw
   d. Sunshade
   e. Bubble tube
   f. Leveling head
   g. Leveling screw
   h. Head plate
   i. Tripod
   j. Leg thumb nut
   k. Slow-motion screw
   l. Clamp

## ANSWERS TO TEST

5. a. Horizontal cross hair
   b. Line of sight
   c. Vertical cross hair

6. a. Target face
   b. Vernier scale
   c. Rod clamp
   d. Target clamp

7. a. 2 c. 1
   b. 4 d. 3

8. Answer should include any five of the following
   a. Protect against shock and vibration when transporting
   b. Keep in case except when in use
   c. Place lens and tripod caps in box after removing from leveling instrument
   d. Attach leveling instrument to tripod carefully and firmly before moving tripod
   e. Never force screws or other moving parts of a leveling instrument
   f. Always use sunshade regardless of weather
   g. Clean lenses with soft tissue
   h. Do not clean lenses with fingers
   i. Do not remove lenses
   j. Loosen setscrews when leveling instrument is not in use

## ANSWERS TO TEST

9. a. Move in this direction
   b. Move up
   c. Wrong face; check clamp; rod upside down
   d. Wave rod from side to side
   e. Turning point
   f. Move in this direction
   g. Come in
   h. Use long rod
   i. Observation completed; move on; understand
   j. Move down

10. a. 2.54
    b. 6.89
    c. 7.90
    d. 3.04

11. Performance skills evaluated to the satisfaction of the instructor

# MORTARS
## UNIT I

## UNIT OBJECTIVE

After completing this unit, the student should be able to list the ingredients used in mortars, state the purpose of mortar, and mix mortar by hand or with a mechanical mixer. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with mortars to their correct definitions.
2. List ingredients used in mortars.
3. Match types of mortar to their recommended uses.
4. State factors to consider when mixing mortar.
5. State the purposes of mortar.
6. Select from a list factors that affect mortar consistency.
7. Select from a list factors that influence selection of mix proportions.
8. Match types of admixtures used in mortar to their results.
9. Discuss the cause and effects of efflorescence in mortar.
10. Select from a list ways of preventing efflorescence.
11. Arrange in order steps for using a mechanical mixer to mix mortar.
12. Arrange in order steps used to mix mortar by hand.
13. State procedures used in the care of the mixer.
14. Demonstrate the ability to
    - a. Mix 1:1:6 mortar with mechanical mixer.
    - b. Mix 1:1:6 mortar by hand.

# MORTARS
## UNIT I

## SUGGESTED ACTIVITIES

I. Suggested activities

   A. Obtain transparencies.

      (NOTE: Transparencies are available from AGC and CIMC.)

   B. Provide students with objective sheet.

   C. Discuss unit and specific objectives.

   D. Provide students with information and job sheets.

   E. Discuss information sheet.

   F. Gather equipment and materials for job sheet demonstrations.

   G. Demonstrate and discuss procedures outlined in job sheets.

   H. For cross-reference on mortar, refer to specifications Part 1.07, 1.09, 2.02, 2.07, 2.12, 3.04, 3.05 in "Basic Plan Reading," Unit III-B, *Bricklaying: Basic Core.*

   I. Give test.

   J. Complete appropriate section of competency profiles.

      (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM #1 — Equipment for Mixing Mortar

      2. TM #2 — Equipment for Mixing Mortar (Continued)

      3. TM #3 — Equipment for Mixing Mortar (Continued

## SUGGESTED ACTIVITIES

E. Job sheets

  1. Job Sheet #1 — Mix 1:1:6 Mortar with Mechanical Mixer

  2. Job Sheet #2 — Mix 1:1:6 Mortar by Hand

F. Test

G. Answers to test

III. Unit reference — Turcotte, Raymond J. *Bricklaying Curriculum*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1977.

# MORTARS
## UNIT I

## INFORMATION SHEET

I. Terms and definitions

  A. Admixture — Component added in small quantities to mortar mix to achieve a specific result

  B. Air-entraining agent — Admixture that incorporates microscopic air bubbles into the mix to increase resilience and durability

  C. Autogenous healing — Ability of hairline cracks in mortar to reknit or reseal themselves

  D. Consistency — Degree of wetness and workability of mortar

  E. Cubic-foot measuring box — Box used to measure dry ingredients used in mortar

  F. Cut — Chopping/pushing/pulling motion done with hoe to mix and blend mortar thoroughly to a desired consistency

  G. Durability — Ability to withstand wear, abrasion, and weathering

  H. Efflorescence — Deposit, usually white in color, of water-soluble salts on masonry surface

  I. Ingredients — Components of a mixture

  J. Masonry cement — Mill-mixed combination of portland cement, lime, and additives

  K. Portland cement — Manufactured product consisting of finely ground and mixed lime, silicon, alumina, iron, and gypsum

  L. psi — Pounds per square inch

  M. Workability — Ease with which mortar can be placed and handled

II. Ingredients used in mortars

  A. Portland cement/lime mortars

    1. Portland cement

    2. Hydrated lime or lime putty

    3. Sand

    4. Water

# INFORMATION SHEET

B. Masonry cement mortars

   1. Masonry cement Type II
   2. Sand
   3. Water

III. Recommended uses of types of mortar

(NOTE: Portland cement/lime mortars and masonry cement mortars are each divided into four types of mortars that are determined by the proportions of their ingredients. The Brick Institute of America [BIA] developed the specifications for the four types of mortar used in brick construction.)

A. Type N (mortar with a medium compressive strength of at least 750 psi after being cured twenty-eight days) — Used for exposed masonry above grade and where high compressive strength or lateral masonry strengths are required

B. Type M (mortar with a high compressive strength of at least 2,500 psi after curing twenty-eight days and with somewhat greater durability than some other types) — Used for masonry below grade and in contact with the earth, such as foundations, retaining walls, manholes; this type will withstand severe frost action and high lateral loads

C. Type S (mortar with a fairly high compressive strength of at least 1,800 psi after curing twenty-eight days) — Used in reinforced masonry and for standard masonry where maximum flexural strength is required; also used when mortar is the sole bonding agent between facing and backing units

D. Type O (mortar with a low compressive strength of at least 350 psi after curing twenty-eight days) — Used for general interior walls; may be used for load-bearing walls of solid masonry if axial compressive stress does not exceed 100 psi and wall will not be exposed to weathering or freezing

EXAMPLES:

## MORTAR PROPORTIONS BY VOLUME

Portland Cement/Lime Mortars

| Type | Portland Cement | Hydrated Lime or Lime Putty | Sand |
|---|---|---|---|
| M | 1 | ¼ | 3 |
| S | 1 | ½ | 4 ½ |
| N | 1 | 1 | 6 |
| O | 1 | 2 | 9 |

## INFORMATION SHEET

Masonry Cement Mortars

| Type | Portland Cement | Masonry Cement | Sand |
|---|---|---|---|
| M | 1 | 1 | 6 |
| S | 1/2 | 1 | 4 1/2 |
| N | — | 1 | 3 |
| O | — | 1 | 3 |

IV. Factors to consider when mixing mortar

- A. Mix to proper consistency
- B. Use materials specified
- C. Use clean water
- D. Mix material for at least three minutes when using mechanical mixer
- E. Cut (turn) material at least three times before adding water when hand mixing
- F. Be consistent with ingredients

  (NOTE: Materials should be carefully measured and thoroughly mixed if uniformity of quality is to be maintained.)

V. Purposes of mortar

- A. Binds masonry units
- B. Seals against air and moisture
- C. Acts as a bond for reinforcement, anchor bolts, metal ties
- D. Enhances appearance

VI. Factors that affect mortar consistency

- A. Air temperature
- B. Wind
- C. Freezing
- D. Proportion of mix
- E. Exposure to sun and heat

## INFORMATION SHEET

F. Mixing time

VII. Factors that influence selection of mix proportions

A. Workability

B. Strength

C. Durability

D. Autogenous healing

E. Cost

VIII. Types of admixtures used in mortar and their results

A. Air-entraining agent — Increases resistance to freezing and thawing and increases life and durability of mortar

**(CAUTION: A mortar mix that has more than 12 percent air-entraining agent will not have a strong bond strength.)**

B. Waterproofing agent — Prevents moisture from penetrating masonry walls

C. Pigment — Produces a desired color to enhance appearance of masonry units and to help create unusual effects

D. Accelerator — Accelerates setting time, thus helping to prevent freezing; increases early strength

IX. Cause and effects of efflorescence in mortar — Efflorescence occurs as a white stain on bricks, which spoils the appearance of the finished product; a chemical reaction between salt and water or chemicals in the atmosphere and the masonry combine to cause this problem

(NOTE: The source of the salt may be the mortar, brick, impure water, unclean sand, or even the atmosphere.)

X. Ways of preventing efflorescence

A. Reduce salt content by using clean sand

B. Use clean water

C. Protect materials from the ground

D. Cover completed product for protection from elements

E. Maintain quality workmanship at all times

## INFORMATION SHEET

XI. Steps for using a mechanical mixer to mix mortar (Transparencies #1-3)

**(CAUTION: Wear goggles to protect the eyes.)**

A. Start mixer

B. Pour in one-half to one-third of the water required

C. Add half of the required amount of sand

(NOTE: Be sure that safety grate is in place.)

D. Add masonry cement or portland cement and lime

E. Add remainder of sand

F. Add enough water to obtain desired consistency

G. Allow mixer to continue running for at least three minutes

H. After mortar has mixed sufficiently, grasp dump handle, release drum latch, and empty mortar into wheelbarrow or mortar box

I. Return drum to upright position, lock, and shut off mixer

XII. Steps used to mix mortar by hand (Transparencies #1-#3)

(NOTE: Use a 1:1:3 proportion.)

A. Level mortar box

B. Shovel about one-half required amount of sand into mortar box

C. Add cement and lime

D. Add remaining half of sand to mix

E. Use hoe to cut and blend material; at the same time, pull the material to one end of mortar box

F. Move to opposite end of mortar box; cut and blend material

G. Cut dry material at least three times

H. Add about one-half the required amount of water

(NOTE: Use bucket when adding water)

## INFORMATION SHEET

I. Remix material, adding water as necessary to obtain desired consistency

(NOTE: Use clean water to clean all tools and equipment at the end of the work day.)

XIII. Procedures used in the care of the mixer

(NOTE: The mixer is an expensive piece of equipment; care for it as if it were your own.)

A. Check mixer for any broken or worn parts before starting

B. Check engine oil level daily

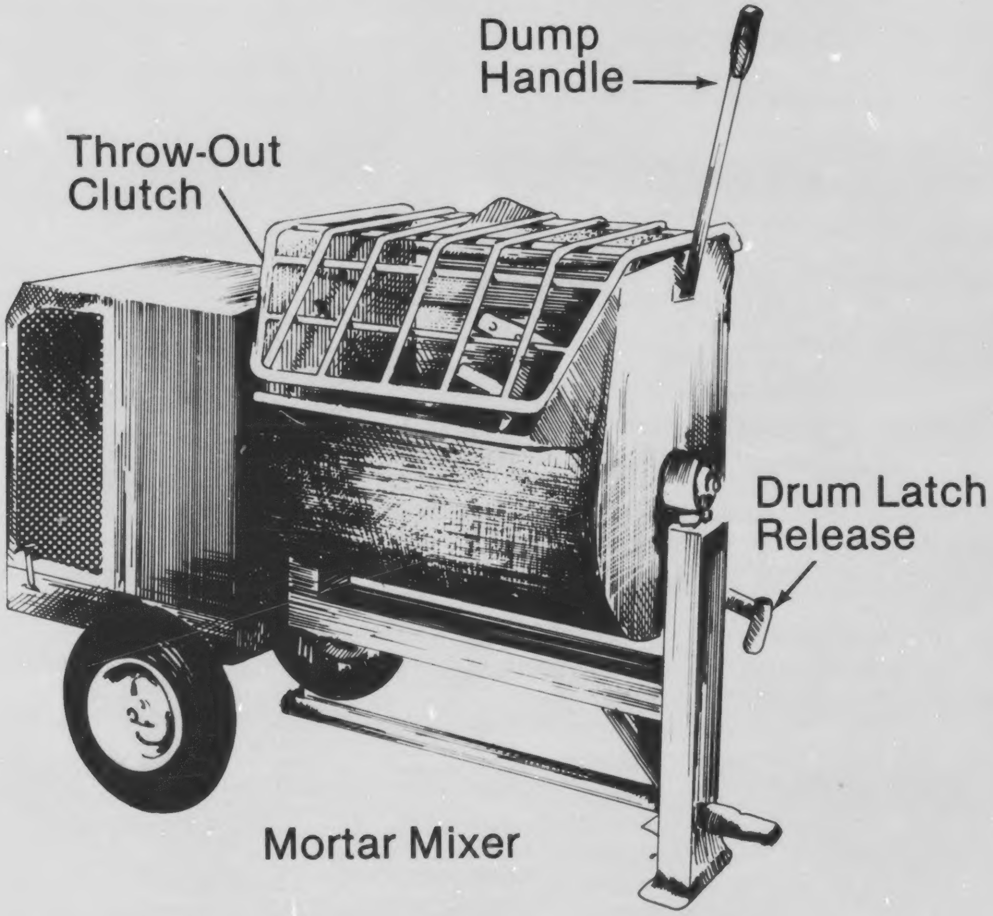
C. Change oil according to manufacturer's specifications

D. Grease all grease fittings regularly

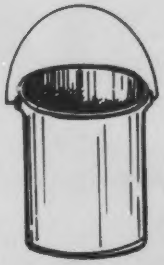
E. Use clean water to wash inside and outside of mixer immediately after last batch is mixed

(NOTE: Add a little water and sand to empty mixer and let run a few minutes after last batch; this will help clean it.)

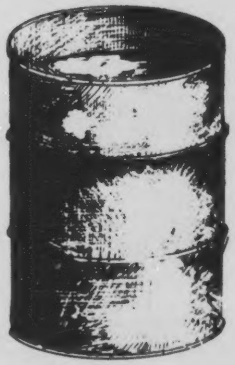
# Equipment for Mixing Mortar


Dump Handle
Throw-Out Clutch
Drum Latch Release

Mortar Mixer



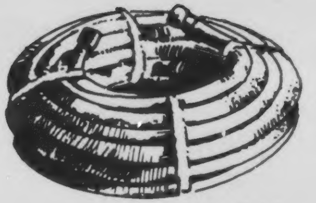
Water Bucket



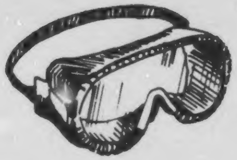
Water Barrel

# Equipment for Mixing Mortar

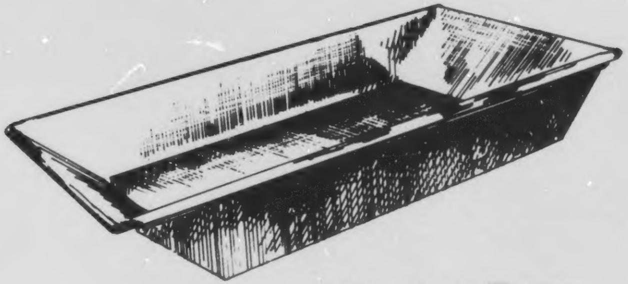
(Continued)



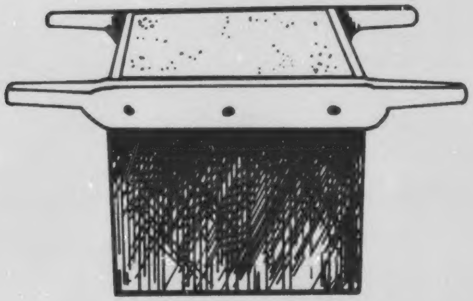
Water Hose



Safety Goggles



Mortar Box



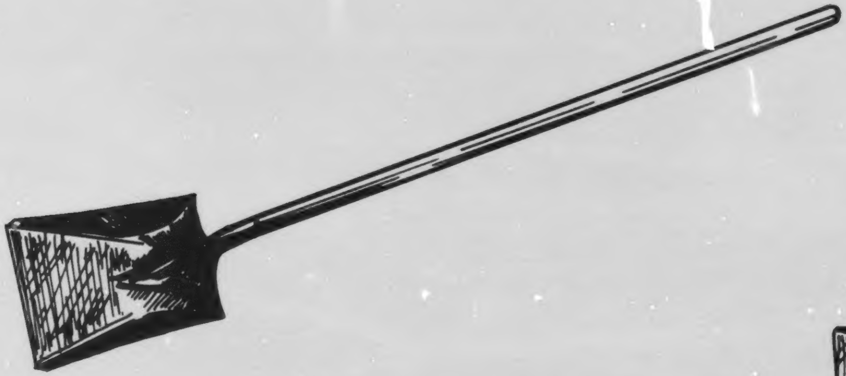
Cubic-Foot Measuring Box

TM #2

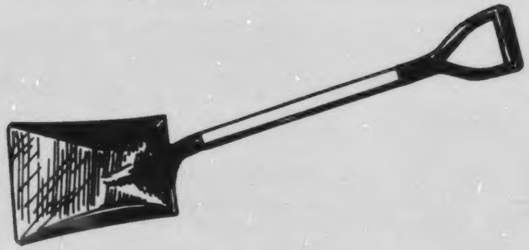
PBL - 13-B

# Equipment for Mixing Mortar

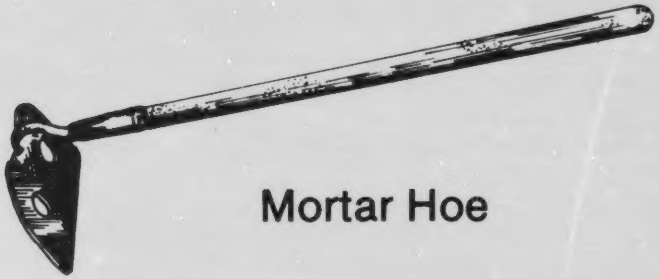
(Continued)



Long-Handled, Square-Point Shovel



Short-Handled, Square-Point Shovel



Mortar Hoe

TM #3

PBL - 15-B

## MORTARS
## UNIT I

### JOB SHEET #1 — MIX 1:1:6 MORTAR WITH MECHANICAL MIXER

I. Equipment and materials

- A. Mortar mixer
- B. Mortar box
- C. Water barrel
- D. Shovels, long- and short-handled, square-point
- E. Bucket, 5-gallon
- F. Water hose with nozzle
- G. Safety goggles
- H. Portland cement, 1 bag (1 cubic foot)
- I. Hydrated lime, 1 cubic foot
- J. Sand, 6 cubic feet
- K. Water
- L. Cubic-foot measuring box

II. Procedure

- A. Check mixer to see that it is level
- B. Check mixing drum to make sure that it is clean
- C. Check gas tank to see that it is full
- D. Make sure that drum's safety guard is down
- E. Start mixer
- F. Close cowl
- G. Engage clutch

  (NOTE: An electric mixer may also be used.)
- H. Put 5 gallons of clean water into drum

## JOB SHEET #1

I. Measure sand, using shovel and cubic-foot measuring box

J. Fill measuring box with sand; dump sand on floor

K. Repeat procedures I and J until you have measured 6 cubic feet of sand

(NOTE: Notice how many shovelfuls of sand are needed to fill the measuring box. When shoveling sand into mixer, you can shovel half of the sand. Make sure you use the same shovel each time.)

L. Shovel into mixer half the measured sand using the square-point shovel

M. Set bag of portland cement on top of drum-guard bag splitter

N. Gradually dump all the cement into drum

O. Set 1 cubic foot of hydrated lime on top of drum-guard

P. Gradually dump lime into drum

Q. Add only enough water so that mixer will not stall

R. Shovel in the remainder of the sand, using square-point shovel

(NOTE: Notice how many shovelfuls of measured sand were used.)

S. Add enough water to drum to get correct consistency

T. Mix materials at least three minutes

U. Wet mortar box with water

V. Hold dump handle firmly at the top, release drum latch, and dump materials into mortar box

(NOTE: Dump material into mortar box only after mortar is mixed to correct consistency.)

W. Push back on drum handle until it is in a locked position

X. Empty 5 gallons of water into drum for next batch

Y. If you are not going to mix more mortar, use water hose with nozzle to clean drum thoroughly while mixer is running

**(CAUTION: Do not use any tools for cleaning drum while mixer is running.)**

Z. Dump water, and continue cleaning drum with water hose until drum is completely clean

AA. Disengage clutch, and shut off engine

BB. Clean work area; clean and put away equipment and materials

# MORTARS
## UNIT I

## JOB SHEET #2 — MIX 1:1:6 MORTAR BY HAND

I. Equipment and materials

- A. Mortar box
- B. Water barrel
- C. Mortar hoe
- D. Shovels, long- and short-handled, square-point
- E. Water hose with nozzle
- F. Bucket, 5-gallon
- G. Safety goggles
- H. Portland cement, 1 bag (1 cubic foot)
- I. Hydrated lime, 1 cubic foot
- J. Sand, 6 cubic feet
- K. Water
- L. Cubic-foot measuring box

II. Procedure

- A. Check to see that mortar box is clean
- B. Level mortar box
- C. Make sure that mortar box is watertight
- D. Measure sand with cubic-foot measuring box
- E. Fill box; dump sand on floor

  (NOTE: Notice number of shovelfuls of sand used to fill box.)
- F. Shovel all the measured sand into mortar box, using square-point shovel
- G. Level sand in mortar box with mortar hoe
- H. Empty bag of portland cement on top of sand in mortar box

## JOB SHEET #2

I. Empty 1 cubic foot of hydrated lime on top of cement

J. Start pulling dry materials to one end of mortar box

K. Pull material to opposite end of box with mortar hoe, using a cutting motion

L. Repeat mixing of dry material once more

M. Empty 5-gallon bucket of clean water at empty end of box

N. Pull dry material into water gradually, mixing with hoe

(NOTE: Use a push/pull motion with hoe.)

O. Continue pulling and mixing until most of the water has been absorbed

P. Add water as needed, and mix materials thoroughly

**(CAUTION: Do not add too much water.)**

Q. Continue mixing and adding water until correct consistency is reached

R. Clean work area; clean and put away equipment and materials

## MORTARS
## UNIT I

## TEST

NAME ________________________________________ SCORE ________________

1. Match terms associated with mortars to their correct definitions. Write the correct numbers in the blanks.

______a. Admixture that incorporates microscopic air bubbles into the mix to increase resilience and durability

______b. Pounds per square inch

______c. Components of a mixture

______d. Ability of hairline cracks in mortar to reknit or reseal themselves

______e. Box used to measure dry ingredients used in mortar

______f. Chopping/pushing/pulling motion done with hoe to mix and blend mortar thoroughly to a desired consistency

______g. Ease with which mortar can be placed and handled

______h. Mill-mixed combination of portland cement, lime, and additives

______i. Deposit, usually white in color, of water-soluble salts on masonry surface

______j. Component added in small quantities to mortar mix to achieve a specific result

______k. Ability to withstand wear, abrasion, and weathering

______l. Manufactured product consisting of finely ground and mixed lime, silicon, alumina, iron, and gypsum

______m. Degree of wetness and workability of mortar

1. Cut
2. Autogenous healing
3. Admixture
4. Portland cement
5. Cubic-foot measuring box
6. psi
7. Consistency
8. Masonry cement
9. Ingredients
10. Durability
11. Air-entraining agent
12. Efflorescence
13. Workability

## TEST

2. List ingredients used in mortars.

a. Portland cement/lime mortars

1) ____________________

2) ____________________

3) ____________________

4) ____________________

b. Masonry cement mortars

1) ____________________

2) ____________________

3) ____________________

3. Match types of mortar to their recommended uses. Write the correct numbers in the blanks.

_____a. Used for exposed masonry above grade and where high compressive strength or lateral masonry strengths are required

_____b. Used for general interior walls; may be used for load-bearing walls of solid masonry if axial compressive stress does not exceed 100 psi and wall will not be exposed to weathering or freezing

_____c. Used for masonry below grade and in contact with the earth, such as foundations, retaining walls, manholes; this type will withstand severe frost action and high lateral loads

_____d. Used in reinforced masonry and for standard masonry where maximum flexural strength is required; also used when mortar is the sole bonding agent between facing and backing units

1. Type S (mortar with a fairly high compressive strength of at least 1,800 psi after curing twenty-eight days)
2. Type O (mortar with a low compressive strength of at least 350 psi after curing twenty-eight days)
3. Type N (mortar with a medium compressive strength of at least 750 psi after being cured twenty-eight days)
4. Type M (mortar with a high compressive strength of at least 2,500 psi after curing twenty-eight days and with somewhat greater durability than some other types)

## TEST

4. State three factors to consider when mixing mortar.

a. ______________________________

b. ______________________________

c. ______________________________

5. State three purposes of mortar.

a. ______________________________

b. ______________________________

c. ______________________________

6. Select from the following list factors that affect mortar consistency. Write an "X" in the blank before each correct answer.

______a. Where it is being mixed

______b. Freezing

______c. Exposure to sun and heat

______d. Air temperature

______e. Type and size of mixing unit

______f. Proportion of mix

______g. Mixing time

______h. Time of year

______i. Wind

7. Select from the following list factors that influence selection of mix proportions. Write an "X" in the blank before each correct answer.

______a. Cost

______b. Durability

______c. Consistency

______d. Workability

______e. Reinforcement

# TEST

______f. Autogenous healing

______g. Strength

8. Match types of admixtures used in mortar to their results. Write the correct numbers in the blanks.

______a. Prevents moisture from penetrating masonry walls

______b. Accelerates setting time, thus helping to prevent freezing; increases early strength

______c. Increases resistance to freezing and thawing and increases life and durability of mortar

______d. Produces a desired color to enhance appearance of masonry units and to help create unusual effects

1. Accelerator
2. Pigment
3. Air-entraining agent
4. Waterproofing agent

9. Discuss the cause and effects of efflorescence in mortar.

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

10. Select from the following list ways of preventing efflorescence. Write an "X" in the blank before each correct answer.

______a. Use a good grade of salt water in mix

______b. Reduce amount of sand

______c. Protect materials from the ground

______d. Maintain quality workmanship at all times

______e. Cover completed product for protection from elements

# TEST

11. Arrange in order steps for using a mechanical mixer to mix mortar. Write a "1" before the first step, a "2" before the second step, and so on.

______a. Add masonry cement or portland cement and lime

______b. Allow mixer to continue running for at least three minutes

______c. Pour in one-half to one-third of the water required

______d. Return drum to upright position, lock, and shut off mixer

______e. Start mixer

______f. Add half of the required amount of sand

______g. Add enough water to obtain desired consistency

______h. After mortar has mixed sufficiently, grasp dump handle, release drum latch, and empty mortar into wheelbarrow or mortar box

______i. Add remainder of sand

12. Arrange in order steps used to mix mortar by hand. Write a "1" before the first step, a "2" before the second step, and so on.

______a. Use hoe to cut and blend material; at the same time, pull the material to one end of mortar box

______b. Remix material, adding water as necessary to obtain desired consistency

______c. Add cement and lime

______d. Move to opposite end of mortar box; cut and blend material

______e. Level mortar box

______f. Add about one-half the required amount of water

______g. Shovel about one-half required amount of sand into mortar box

______h. Cut dry material at least three times

______i. Add remaining half of sand to mix

## TEST

13. State three procedures used in the care of the mixer.

    a. ______________________________________________

    ______________________________________________

    b. ______________________________________________

    ______________________________________________

    c. ______________________________________________

    ______________________________________________

(NOTE: Test question 14 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

14. Demonstrate the ability to

    a. Mix 1:1:6 mortar with mechanical mixer.

    b. Mix 1:1:6 mortar by hand.

# MORTARS
# UNIT I

## ANSWERS TO TEST

1. a. 11
   b. 6
   c. 9
   d. 2
   e. 5
   f. 1
   g. 13
   h. 8
   i. 12
   j. 3
   k. 10
   l. 4
   m. 7

2. a. Portland cement/lime mortars
      1) Portland cement
      2) Hydrated lime or lime putty
      3) Sand
      4) Water
   b. Masonry cement mortars
      1) Masonry cement Type II
      2) Sand
      3) Water

3. a. 3
   b. 2
   c. 4
   d. 1

4. Answer should include any three of the following
   a. Mix to proper consistency
   b. Use materials specified
   c. Use clean water
   d. Mix material for at least three minutes when using mechanical mixer
   e. Cut (turn) material at least three times before adding water when hand mixing
   f. Be consistent with ingredients

## ANSWERS TO TEST

5. Answer should include any three of the following

   a. Binds masonry units

   b. Seals against air and moisture

   c. Acts as a bond for reinforcement, anchor bolts, metal ties

   d. Enhances appearance

6. b, c, d, f, g, i

7. a, b, d, f, g

8.

| | | | |
|---|---|---|---|
| a. | 4 | c. | 3 |
| b. | 1 | d. | 2 |

9. Discussion should include the following

   Efflorescence occurs as a white stain on bricks, which spoils the appearance of the finished product; a chemical reaction between salt and water or chemicals in the atmosphere and the masonry combine to cause this problem

10. c, d, e

11.

| | | | | | |
|---|---|---|---|---|---|
| a. | 4 | d. | 9 | g. | 6 |
| b. | 7 | e. | 1 | h. | 8 |
| c. | 2 | f. | 3 | i. | 5 |

12.

| | | | | | |
|---|---|---|---|---|---|
| a. | 5 | d. | 6 | g. | 2 |
| b. | 9 | e. | 1 | h. | 7 |
| c. | 3 | f. | 8 | i. | 4 |

13. Answer should include any three of the following

    a. Check mixer for broken or worn parts before starting

# ANSWERS TO TEST

b. Check engine oil level daily

c. Change oil according to manufacturer's specifications

d. Grease all grease fittings regularly

e. Use clean water to wash inside and outside of mixer immediately after last batch is mixed

14. Performance skills evaluated to the satisfaction of the instructor

# MASONRY UNITS
## UNIT II

## UNIT OBJECTIVE

After completing this unit, the student should be able to identify different types of bricks and blocks, match bond types to their meanings, and lay out a brick wall using dry bond method. The student will show this knowledge by completing the job sheet and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with masonry units to their correct definitions.
2. Name types of brick.
3. Match brick sizes to their correct names.
4. State factors to consider when selecting brick.
5. Label a brick, using the correct nomenclature.
6. Identify brick positions as they appear in a wall.
7. Describe absorption characteristics of hard and soft brick.
8. State important properties of brick.
9. Distinguish among types of bonds.
10. Label basic structural bonds.
11. Identify common concrete masonry units.
12. Select from a list sizes of most commonly used concrete masonry units.
13. Label a block, using the correct nomenclature.
14. State rules to follow when bonding masonry materials.
15. Demonstrate the ability to lay out a brick wall using dry bond method.

# MASONRY UNITS
## UNIT II

## SUGGESTED ACTIVITIES

I. Suggested activities

  A. Obtain transparencies.

  (NOTE: Transparencies are available from AGC and CIMC.)

  B. Provide students with objective sheet.

  C. Discuss unit and specific objectives.

  D. Provide students with information and job sheets.

  E. Discuss information sheet.

  F. Gather equipment and materials for job sheet demonstration.

  G. Demonstrate and discuss procedures outlined in job sheet.

  H. Provide different types of masonry units for students to see.

  I. For cross-reference on masonry units, refer to specifications, Parts 2.04, 2.05, 3.05, and 3.08 in "Basic Plan Reading."

  J. Give test.

  K. Complete appropriate section of competency profiles.

  (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

  A. Objective sheet

  B. Suggested activities

  C. Information sheet

  D. Transparency masters

    1. TM #1 — Brick Sizes

    2. TM #2 — Brick Sizes (Continued)

    3. TM #3 — Brick Sizes (Continued)

## SUGGESTED ACTIVITIES

4. TM #4 — Brick Positions
5. TM #5 — Structural Bonds
6. TM #6 — Common Concrete Masonry Units
7. TM #7 — Common Concrete Masonry Units (Continued)

E. Job Sheet #1 — Lay Out a Brick Wall Using Dry Bond Method

F. Test

G. Answers to test

III. Unit references

A. *Chandler Materials Company Catalog*. Tulsa, Oklahoma: Chandler Materials Company, n.d.

B. Kreh, R.T., Sr. *Masonry Skills*. Albany, New York: Delmar Publishers, Inc., 1982.

C. *Technical Notes on Brick Construction*. McLean, Virginia: Brick Institute of America, October, 1971.

D. Turcotte, Raymond J. *Bricklaying Curriculum*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and the Associated General Contractors of America, 1977.

# MASONRY UNITS
## UNIT II

## INFORMATION SHEET

I. Terms and definitions

   A. Absorption rate — Weight or amount of water a masonry unit absorbs at certain conditions for a stated length of time

   B. Adhesion — Ability of mortar to stick to masonry unit

   C. Compressive strength — Brick's resistance to increasing loads or stress placed on it before it breaks

   D. Dimensions — Measurements or sizes

   E. Durability — Ability to withstand wear, abrasion, and weathering

   F. Modular — Refers to standardized units or dimensions for flexibility and variety in use

   G. Mortar bond — Adhesion of mortar to masonry unit, wall ties, or other reinforcement

   H. Nomenclature — Naming of portions or segments of a masonry unit

   I. Nonmodular — Refers to variations in size of standard brick and oversize brick

   J. Pattern bond — Arrangement of masonry units to form a pattern, design, or texture

   K. Setting time — Length of time required for mortar to harden enough to sustain the weight of masonry set on top of it

   L. Standard modular brick — Brick with nominal dimensions of $2\frac{2}{3}$" × 4" × 8"

   M. Stretcher — Brick laid in horizontal position with longest, narrowest side facing front of wall; most common position in which bricks are laid

   N. Structural bond — Arrangement in which individual units are interlocked or tied together to distribute weight of wall

   O. Texture — Arrangement of particles of raw materials in brick; appearance and finish of a brick

II. Types of brick

   (NOTE: There are many different kinds and sizes of brick available today, but there are only two types.)

   A. Building brick

   B. Face brick

## INFORMATION SHEET

III. Sizes of brick (Transparencies #1-#3)

(NOTE: Brick size is designed for the size of the mortar joint. Names for different brick sizes vary according to manufacturer.)

A. Modular — 4″ × 2⅔″ × 8″

B. Nonmodular — 3¾″ × 2¼″ × 8″

C. Norman — 4″ × 2⅔″ × 12″

D. Roman — 4″ × 2″ × 12″

E. Norwegian — 4″ × 3⅕″ × 12″

F. Engineer — 4″ × 3⅕″ × 8″

G. Oversize — 3¾″ × 2¾″ × 8″

H. Economy 8 or jumbo closure — 4″ × 4″ × 8″

I. Double — 4″ × 5⅓″ × 8″

J. Economy 12 or jumbo utility — 4″ × 4″ × 12″

K. Triple — 4″ × 5⅓″ × 12″

L. SCR — 6″ × 2⅔″ × 12″

M. 6-inch Norwegian — 6″ × 3⅕″ × 12″

N. 6-inch jumbo — 6″ × 4″ × 12″

O. 8-inch jumbo — 8″ × 4″ × 12″

P. 3-inch — 3″ × 2⅝″ × 9⅝″ or 3″ × 2¾″ × 9¾″

IV. Factors to consider when selecting brick

A. Composition

B. Manufacturing method

C. Strength

D. Appearance

E. Color

## INFORMATION SHEET

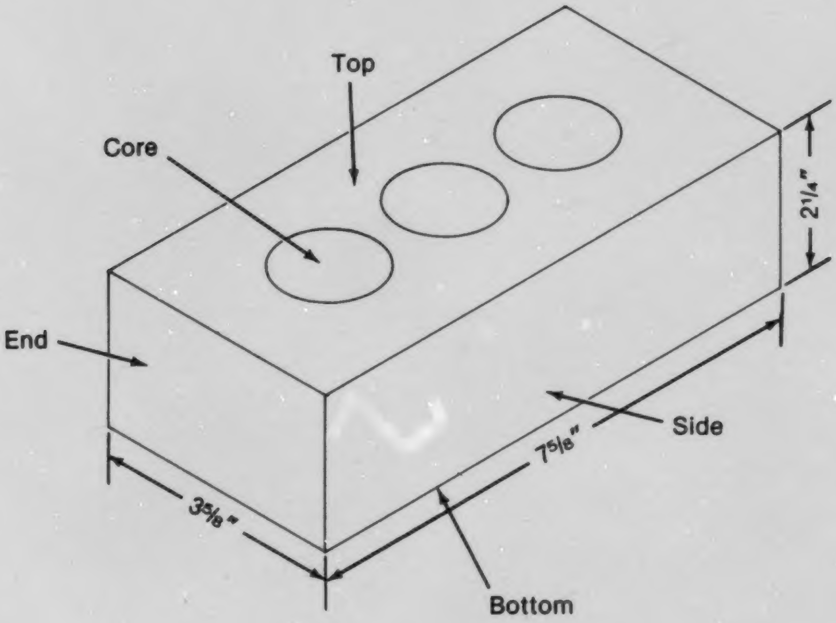
F. Special effects

G. Economy

V. Brick nomenclature (Figure 1)

(NOTE: The face of a brick could be the top, side, or end, depending on the position of the brick in the wall.)

FIGURE 1



VI. Brick positions (Transparency #4)

A. Stretcher

B. Header

C. Soldier

D. Shiner

E. Rowlock

F. Sailor

# INFORMATION SHEET

VII. Absorption characteristics of hard and soft brick

(NOTE: The rate of absorption [suction rate] of a brick partially immersed in water for one minute is important to a bricklayer. Knowing the effects of the absorption rate on mortar and bond helps identify setting time.)

A. Hard brick

1. Very dense
2. Low suction or absorption rate
3. Slow setting

B. Soft brick

1. Porous
2. High suction or absorption rate
3. Fast setting

VIII. Important properties of brick

A. Color

B. Texture

C. Size variation

D. Absorption rate

E. Compressive strength

F. Durability

IX. Types of bonds

(NOTE: All bonds should be structurally strong, provide good adhesion, and maintain the pattern or design specified.)

A. Mortar bond — Adhesion of masonry unit with joint mortar

B. Structural bond — Interlocking of masonry units with each other

C. Pattern bond — Arrangement of masonry units to form a pattern or design

## INFORMATION SHEET

X. Basic structural bonds (Transparency #5)

(NOTE: There are several variations of each of the basic structural bonds.)

- A. Running (stretcher)
- B. Common (American)
- C. Flemish
- D. English
- E. Stack

XI. Common concrete masonry units (Transparencies #6 and #7)

- A. Stretcher
- B. Corner
- C. Jamb
- D. Control joint
- E. Header
- F. Bond beam
- G. Return corner
- H. Sound absorbing
- I. Pilaster
- J. Combination jamb
- K. Conduit
- L. Bullnose
- M. Ornamental
- N. Chimney unit

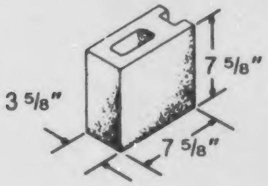
## INFORMATION SHEET

XII. Actual and nominal sizes of most commonly used concrete masonry units (Figures 2-14)

A. 4" × 8" × 8"

EXAMPLE:

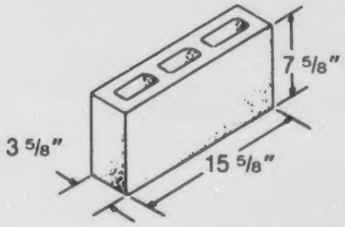
FIGURE 2



B. 4" × 8" × 16"

EXAMPLE:

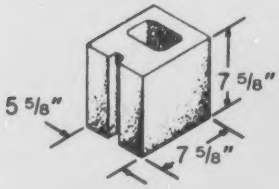
FIGURE 3


7 5/8"
3 5/8"
15 5/8"

C. 6" × 8" × 8"

EXAMPLE:

FIGURE 4

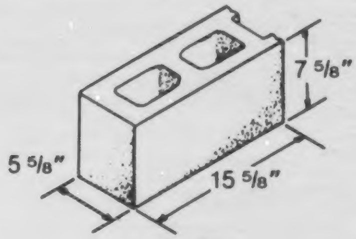


## INFORMATION SHEET

D. 6" × 8" × 16"

EXAMPLE:

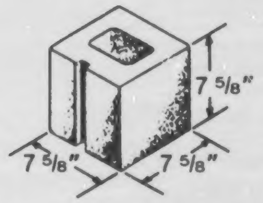
FIGURE 5


7 5/8"
5 5/8"
15 5/8"

E. 8" × 8" × 8"

EXAMPLE:

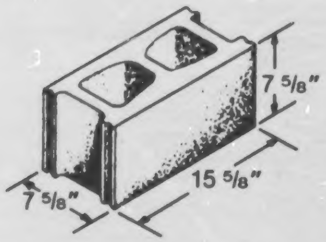
FIGURE 6



F. 8" × 8" × 16"

EXAMPLE:

FIGURE 7

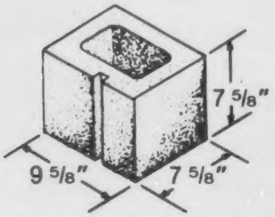

7 5/8"
7 5/8"
15 5/8"

## INFORMATION SHEET

G. 10″ × 8″ × 8″

EXAMPLE:

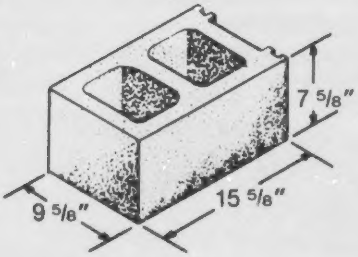
FIGURE 8



H. 10″ × 8″ × 16″

EXAMPLE:

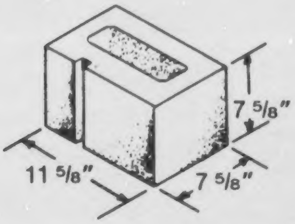
FIGURE 9


7 5/8″
9 5/8″
15 5/8″

I. 12″ × 8″ × 8″

EXAMPLE:

FIGURE 10

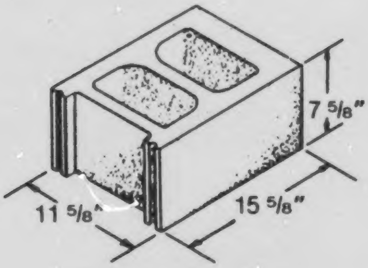

7 5/8″
11 5/8″
7 5/8″

INFORMATION SHEET

J. 12" × 8" × 16"

EXAMPLE:

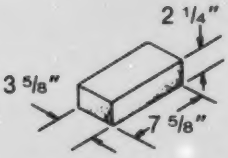
FIGURE 11


7 5/8"
11 5/8"
15 5/8"

K. 2" × 4" × 8" solid

EXAMPLE:

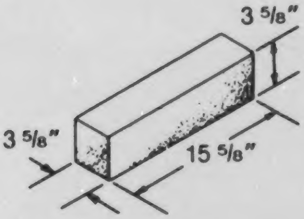
FIGURE 12



L. 4" × 4" × 16" solid

EXAMPLE:

FIGURE 13

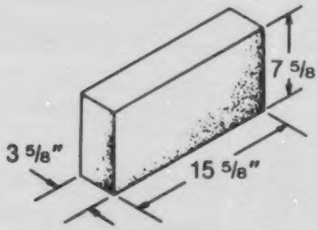

3 5/8"
3 5/8"
15 5/8"

## INFORMATION SHEET

M. 4" × 8" × 16" solid

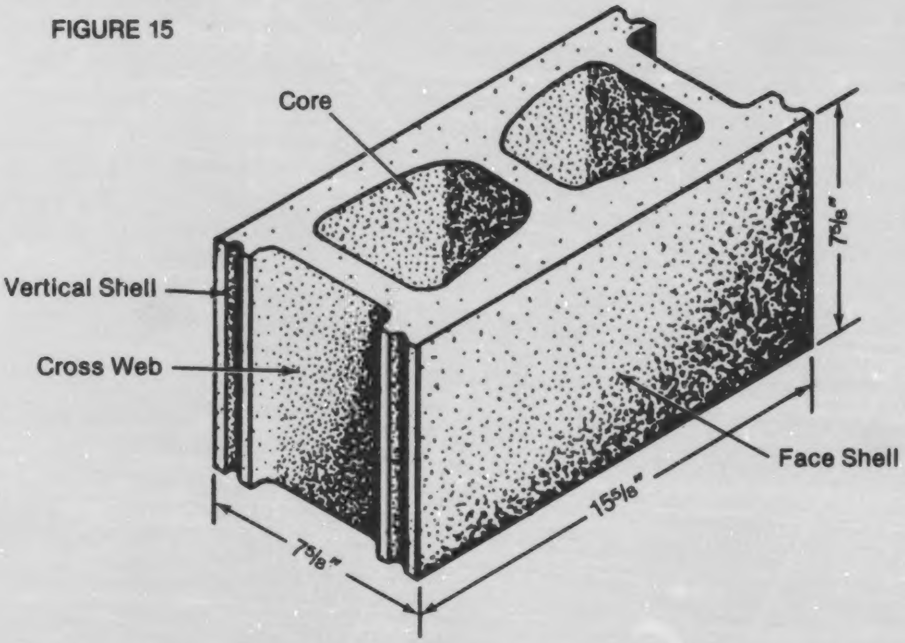
EXAMPLE:

FIGURE 14


7 5/8"
3 5/8"
15 5/8"

XIII. Block nomenclature (Figure 15)

FIGURE 15


Core
Vertical Shell
Cross Web
Face Shell
7⅝"
15⅝"
7⅝"

XIV. Rules to follow when bonding masonry materials

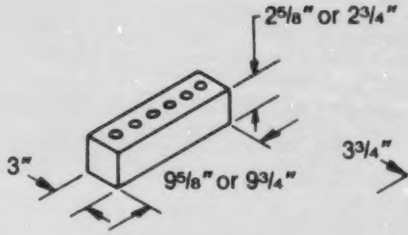
A. Keep bond plumb

B. Keep walls level with backing material

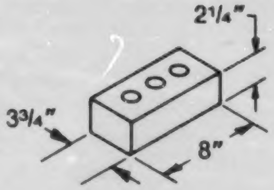
C. Maintain set of mortar bond

# Brick Sizes

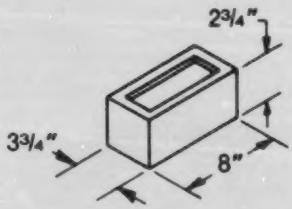
## Nonmodular Brick (Actual Dimensions)


2 5/8" or 2 3/4"
3"
9 5/8" or 9 3/4"

3-Inch



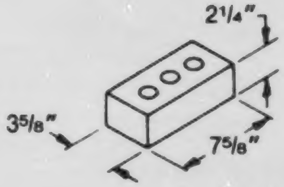
Nonmodular



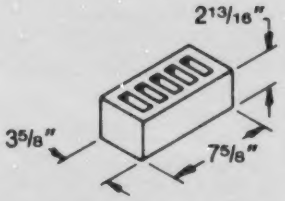
Oversize

## Modular Brick (Actual Dimensions for 3/8-Inch Joints)

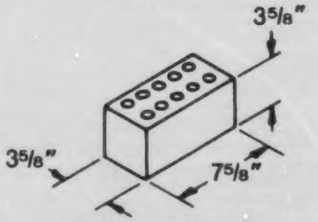
(NOTE: While the coring types shown are typical for solid units, they do not necessarily apply to specific types of units with which they are shown. They will vary with the manufacturer.)



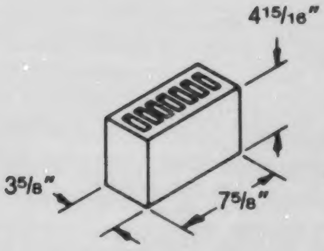
Modular


2 13/16"
3 5/8"
7 5/8"

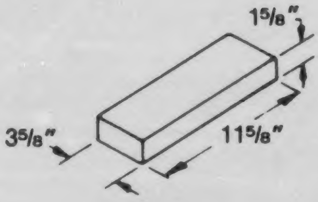
Engineer



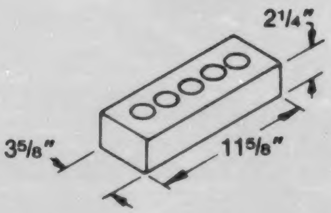
Economy 8 or
Jumbo Closure


4 15/16"
3 5/8"
7 5/8"

Double


1 5/8"
3 5/8"
11 5/8"

Roman

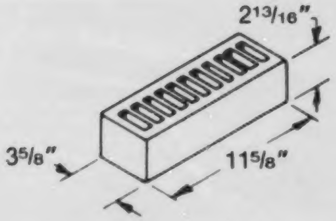

2 1/4"
3 5/8"
11 5/8"

Norman

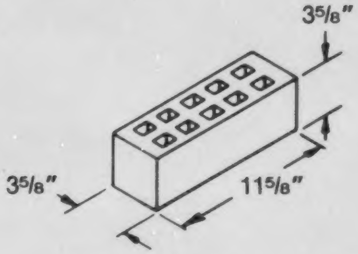
# Brick Sizes

## (Continued)

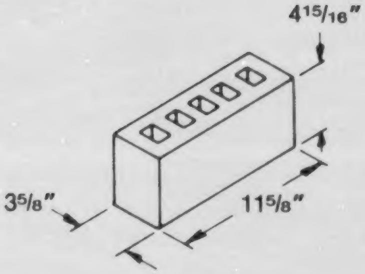
### Modular Brick (Actual Dimensions for 3/8-Inch Joints)


2 13/16"
3 5/8"
11 5/8"

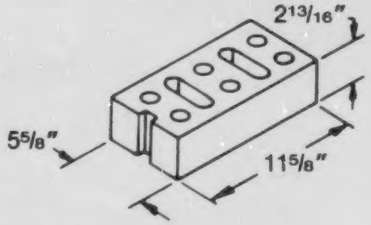
Norwegian


3 5/8"
3 5/8"
11 5/8"

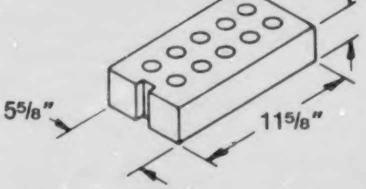
Economy 12 or
Jumbo Utility


4 15/16"
3 5/8"
11 5/8"

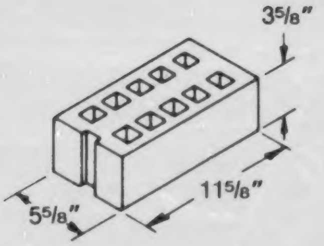
Triple


2 13/16"
5 5/8"
11 5/8"

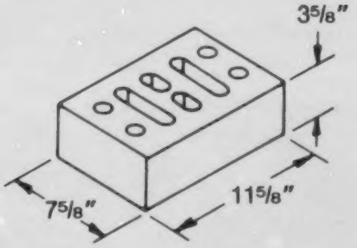
6-Inch
Norwegian


2 1/4"
5 5/8"
11 5/8"

SCR


3 5/8"
5 5/8"
11 5/8"

6-Inch Jumbo


3 5/8"
7 5/8"
11 5/8"

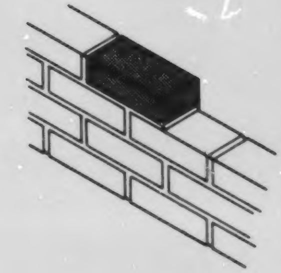
8-Inch Jumbo

# Brick Sizes
## (Continued)

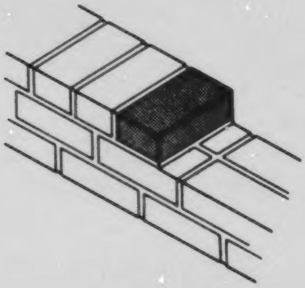
| *Unit Designation* | *Nominal Dimensions* | | | *Joint Thickness (Inches)* | *Actual Dimensions* | | |
|---|---|---|---|---|---|---|---|
| | *t* | *h* | *l* | | *t* | *h* | *l* |
| Modular | 4 | 2 2/3 | 8 | 3/8 | 3 5/8 | 2 1/4 | 7 5/8 |
| | | | | 1/2 | 3 1/2 | 2 1/4 | 7 1/2 |
| Engineer | 4 | 3 1/5 | 8 | 3/8 | 3 5/8 | 2 13/16 | 7 5/8 |
| | | | | 1/2 | 3 1/2 | 2 11/16 | 7 1/2 |
| Economy 8 or Jumbo Closure | 4 | 4 | 8 | 3/8 | 3 5/8 | 3 5/8 | 7 5/8 |
| | | | | 1/2 | 3 1/2 | 3 1/2 | 7 1/2 |
| Double | 4 | 5 1/3 | 8 | 3/8 | 3 5/8 | 4 15/16 | 7 5/8 |
| | | | | 1/2 | 3 1/2 | 4 13/16 | 7 1/2 |
| Roman | 4 | 2 | 12 | 3/8 | 3 5/8 | 1 5/8 | 11 5/8 |
| | | | | 1/2 | 3 1/2 | 1 1/2 | 11 1/2 |
| Norman | 4 | 2 2/3 | 12 | 3/8 | 3 5/8 | 2 1/4 | 11 5/8 |
| | | | | 1/2 | 3 1/2 | 2 1/4 | 11 1/2 |
| Norwegian | 4 | 3 1/5 | 12 | 3/8 | 3 5/8 | 2 13/16 | 11 5/8 |
| | | | | 1/2 | 3 1/2 | 2 11/16 | 11 1/2 |
| Economy 12 or Jumbo Utility | 4 | 4 | 12 | 3/8 | 3 5/8 | 3 5/8 | 11 5/8 |
| | | | | 1/2 | 3 1/2 | 3 1/2 | 11 1/2 |
| Triple | 4 | 5 1/3 | 12 | 3/8 | 3 5/8 | 4 15/16 | 11 5/8 |
| | | | | 1/2 | 3 1/2 | 4 13/16 | 11 1/2 |
| SCR | 6 | 2 2/3 | 12 | 3/8 | 5 5/8 | 2 1/4 | 11 5/8 |
| | | | | 1/2 | 5 1/2 | 2 1/4 | 11 1/2 |
| 6-Inch Norwegian | 6 | 3 1/5 | 12 | 3/8 | 5 5/8 | 2 13/16 | 11 5/8 |
| | | | | 1/2 | 5 1/2 | 2 11/16 | 11 1/2 |
| 6-Inch Jumbo | 6 | 4 | 12 | 3/8 | 5 5/8 | 3 5/8 | 11 5/8 |
| | | | | 1/2 | 5 1/2 | 3 1/2 | 11 1/2 |
| 8-Inch Jumbo | 8 | 4 | 12 | 3/8 | 7 5/8 | 3 5/8 | 11 5/8 |
| | | | | 1/2 | 7 1/2 | 3 1/2 | 11 1/2 |

PBL - 51-B

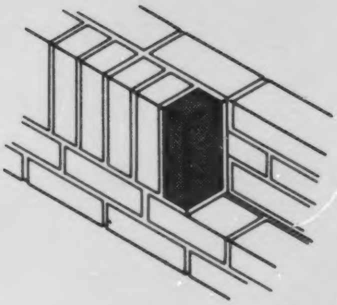
# Brick Positions



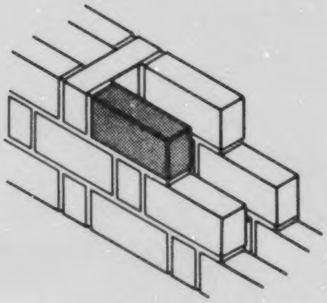
**Stretcher**



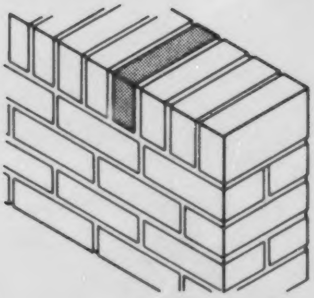
**Header**



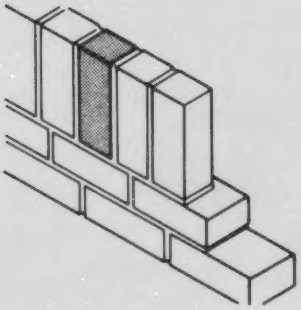
**Soldier**



**Shiner**



**Rowlock**

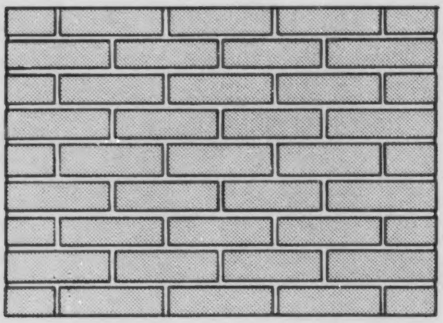


**Sailor**

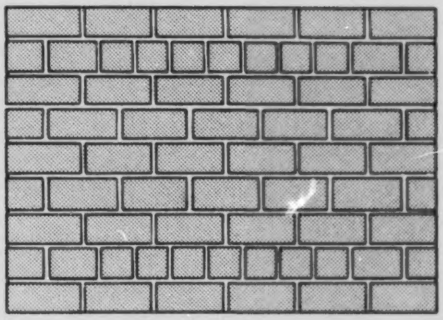
240

TM #4

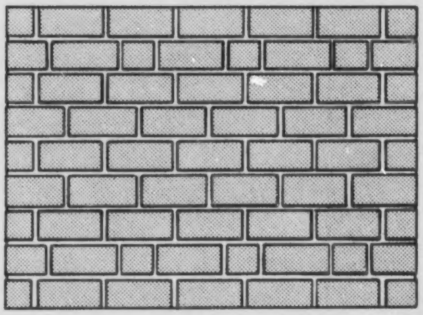
# Structural Bonds



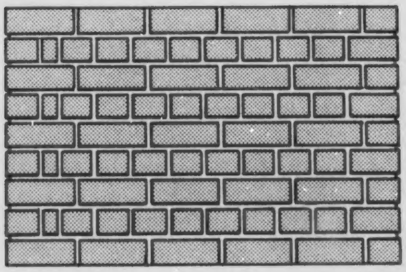
Running (Stretcher)



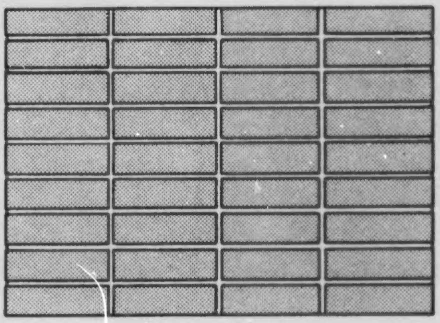
Common (American)



Flemish

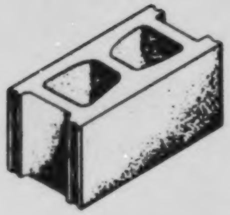


English

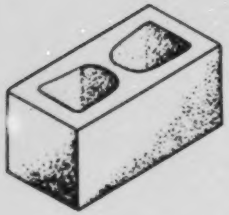


Stack

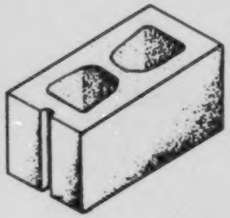
# Common Concrete Masonry Units



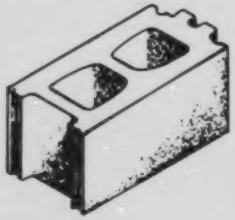
Stretcher



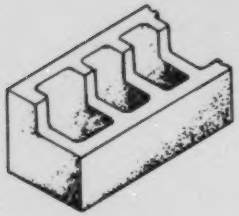
Corner



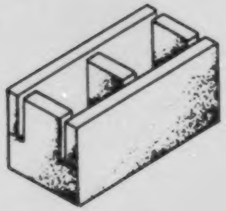
Jamb



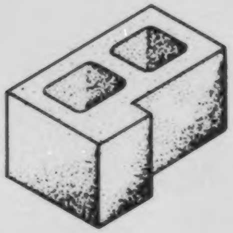
Control Joint



Header

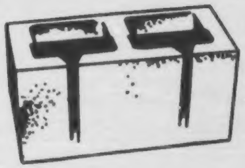


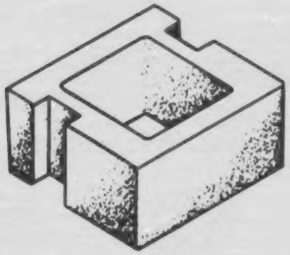
Bond Beam

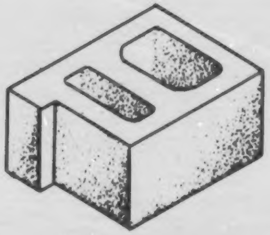


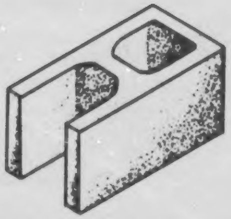
Return Corner

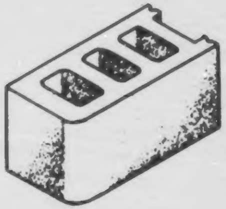
# Common Concrete Masonry Units
(Continued)

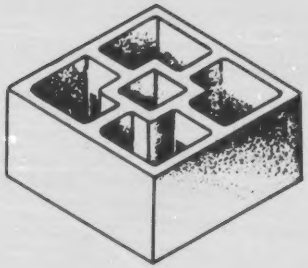

**Sound Absorbing**

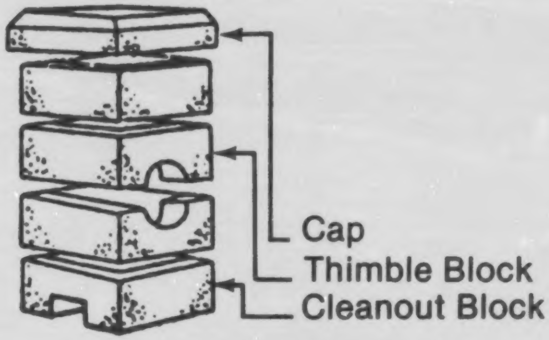

**Pilaster**


**Combination Jamb**


**Conduit**


**Bullnose**


**Ornamental**


Cap
Thimble Block
Cleanout Block
**Chimney Unit**

TM #7

PBL - 57-B

# MASONRY UNITS
## UNIT II

## JOB SHEET #1 — LAY OUT A BRICK WALL USING DRY BOND METHOD

I. Equipment and materials

   A. Bricks

   B. Premeasured wall line and corner

   C. Pencil

II. Procedure

   A. Select enough bricks to lay out a wall 10 feet long

   B. Start at the beginning point (corner)

   C. Lay first brick even with corner mark and even with wall line

   D. Lay second brick even with wall line, with index finger inserted between the two bricks as a gauge for head joint

   (NOTE: Using the index finger as a gauge, the joint should measure approximately $^3/_8$ inch, the normal size of a head joint.)

   E. Continue laying complete wall using this dry bond procedure

   F. Check to determine whether the joints must be opened or tightened to work out evenly; make necessary adjustments

   (NOTE: It may be necessary to turn the first brick on the corner 90 degrees and tighten joints to make up difference.)

   G. After adjustments have been made, mark on floor location of ends of each brick

   H. Mortar may now be added and the wall laid permanently

   I. Clean work area; put away equipment and materials

# MASONRY UNITS
# UNIT II

## TEST

NAME ________________________________________ SCORE ________________

1. Match terms associated with masonry units to their correct definitions. Write the correct numbers in the blanks. Definitions are continued on the following page.

______a. Ability of mortar to stick to masonry unit

______b. Refers to variations in size of standard brick and oversize brick

______c. Ability to withstand wear, abrasion, and weathering

______d. Measurements or sizes

______e. Naming of portions or segments of a masonry unit

______f. Brick with nominal dimensions of 2²/₃" × 4" × 8"

______g. Adhesion of mortar to masonry unit, wall ties, or other reinforcement

______h. Arrangement of particles of raw materials in brick; appearance and finish of a brick

______i. Weight or amount of water a masonry unit absorbs at certain conditions for a stated length of time

______j. Brick's resistance to increasing loads or stress placed on it before it breaks

______k. Brick laid in horizontal position with longest, narrowest side facing front of wall; most common position in which bricks are laid

______l. Arrangement of masonry units to form a pattern, design, or texture

______m. Length of time required for mortar to harden enough to sustain the weight of masonry set on top of it

1. Nomenclature
2. Absorption rate
3. Adhesion
4. Pattern bond
5. Mortar bond
6. Modular
7. Nonmodular
8. Compressive strength
9. Setting time
10. Durability
11. Stretcher
12. Structural bond
13. Dimensions
14. Texture
15. Standard modular brick

## TEST

______n. Arrangement in which individual units are interlocked or tied together to distribute weight of wall

______o. Refers to standardized units or dimensions for flexibility and variety in use

2. Name types of brick.

a. ______________________________

b. ______________________________

3. Match brick sizes to their correct names. Write the correct numbers in the blanks.

______a. Triple
______b. SCR
______c. Norman
______d. 3-inch
______e. Oversize
______f. 6-inch jumbo
______g. Modular
______h. Norwegian
______i. Economy 12 or jumbo utility
______j. Roman
______k. 8-inch jumbo
______l. Double
______m. Nonmodular
______n. Economy 8 or jumbo closure
______o. Engineer
______p. 6-inch Norwegian

1. 3″ × 2 5/8″ × 9 5/8″ or 3″ × 2 3/4″ × 9 3/4″
2. 8″ × 4″ × 12″
3. 4″ × 4″ × 8″
4. 4″ × 3 1/5″ × 12″
5. 6″ × 3 1/5″ × 12″
6. 4″ × 5 1/3″ × 12″
7. 4″ × 3 1/5″ × 8″
8. 3 3/4″ × 2 1/4″ × 8″
9. 3 3/4″ × 2 3/4″ × 8″
10. 4″ × 2″ × 12″
11. 4″ × 2 2/3″ × 8″
12. 4″ × 2 2/3″ × 12″
13. 6″ × 2 2/3″ × 12″
14. 4″ × 5 1/3″ × 8″
15. 6″ × 4″ × 12″
16. 4″ × 4″ × 12″

## TEST

4. State four factors to consider when selecting brick.

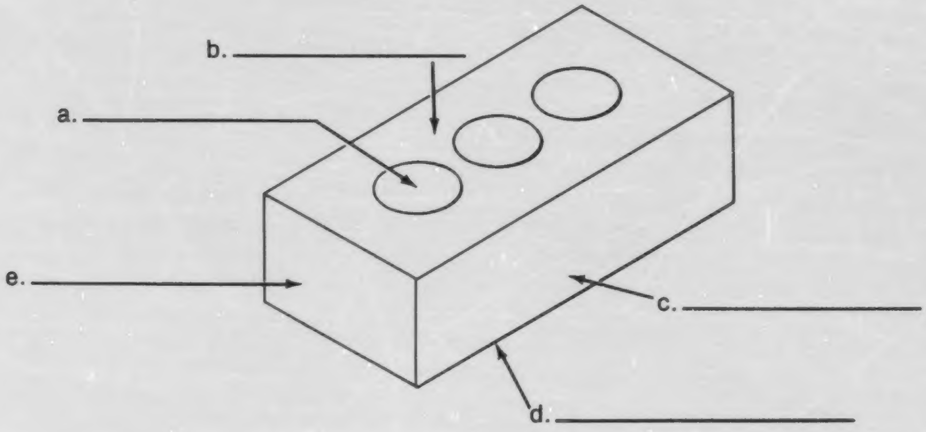
   a. ____________________

   b. ____________________

   c. ____________________

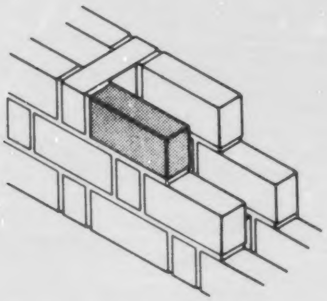
   d. ____________________

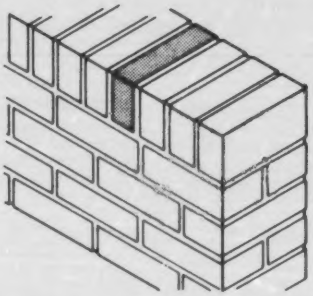
5. Label the brick below, using the correct nomenclature.



6. Identify brick positions as they appear in the walls illustrated. Write the correct names in the blanks.

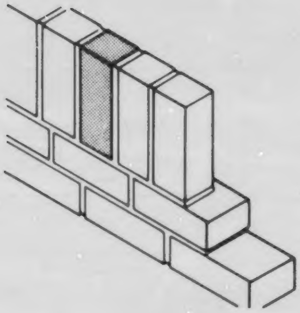
**Stretcher**
**Soldier**
**Rowlock**
**Shiner**
**Sailor**
**Header**



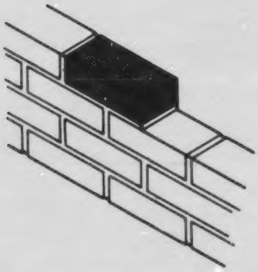


a. ____________________ b. ____________________

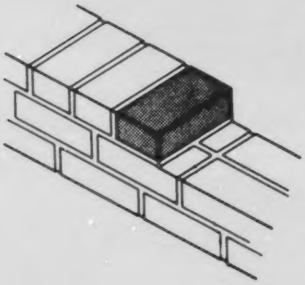
TEST



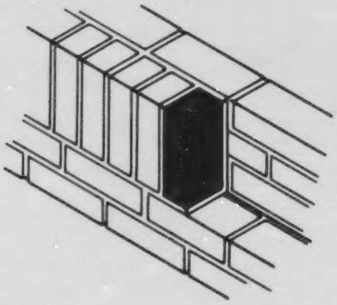
c. ______________________________



d. ______________________________



e. ______________________________



f. ______________________________

7. Describe absorption characteristics of hard and soft brick.

a. Hard brick

1) ______________________________

2) ______________________________

3) ______________________________

b. Soft brick

1) ______________________________

2) ______________________________

3) ______________________________

## TEST

8. State four important properties of brick.

a. ________________________________________

b. ________________________________________

c. ________________________________________

d. ________________________________________

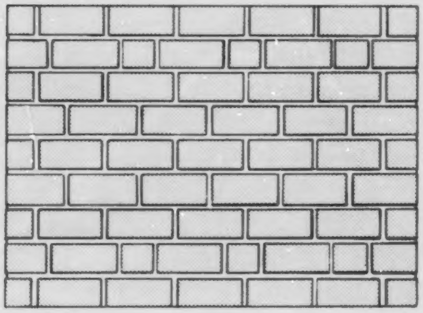
9. Distinguish among types of bonds. Write an "M" in the blank before mortar bond, an "S" in the blank before structural bond, and a "P" in the blank before pattern bond.

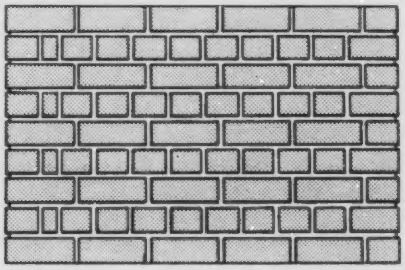
______a. Arrangement of masonry units to form a pattern or design

______b. Adhesion of masonry unit with joint mortar

______c. Interlocking of masonry units with each other

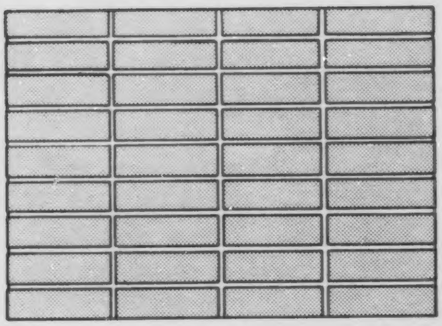
10. Label the basic structural bonds illustrated below.



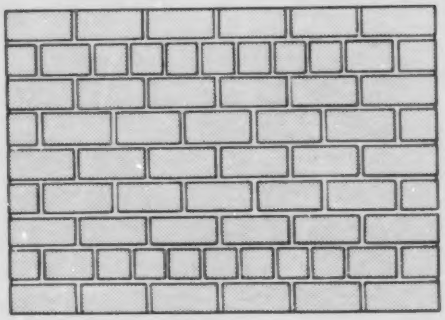


a. ______________________ b. ______________________

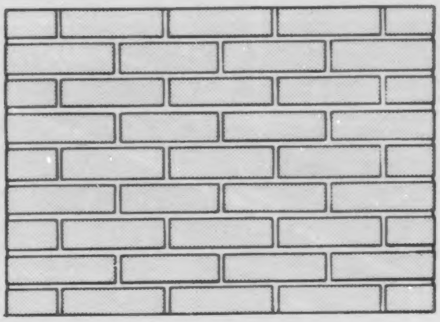
## TEST



c. ____________________



d. ____________________

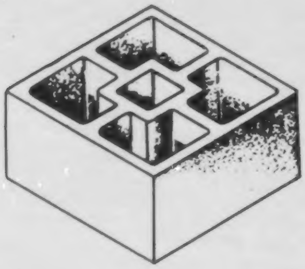


e. ____________________

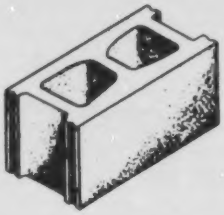
## TEST

11. Identify the common concrete masonry units illustrated below. Write the correct names in the blanks.

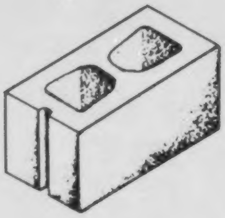
**Sound absorbing**
**Chimney unit**
**Combination jamb**
**Corner**
**Jamb**
**Conduit**
**Stretcher**
**Header**
**Ornamental**
**Return corner**
**Bond beam**
**Control joint**
**Pilaster**
**Bullnose**



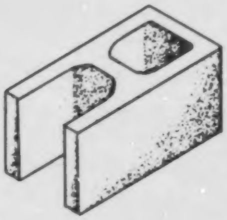
a. ______________________



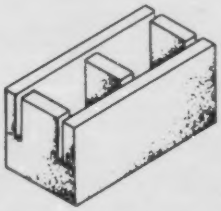
b. ______________________



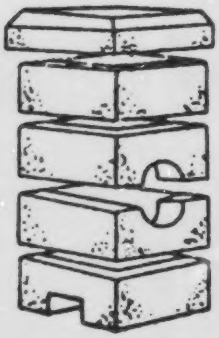
c. ______________________



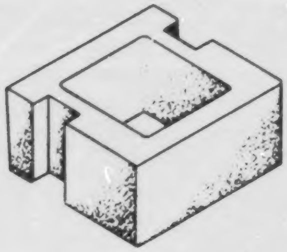
d. ______________________



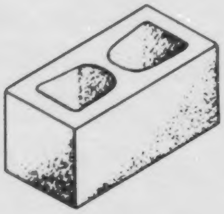
e. ______________________



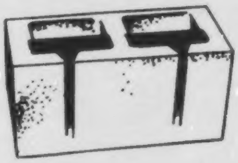
f. ______________________



g. ______________________

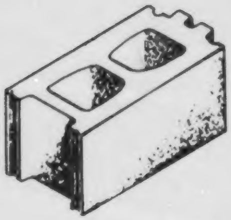


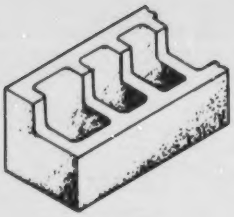
h. ______________________

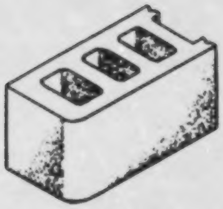


i. ______________________

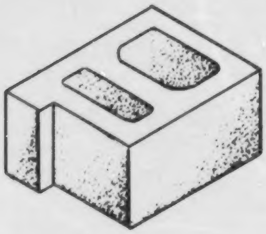
# TEST

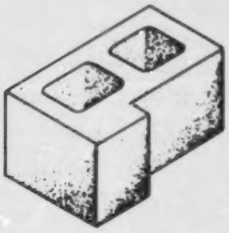






j. ____________ k. ____________ l. ____________





m. ____________ n. ____________

12. Select from the following list sizes of the most commonly used concrete masonry units. Write an "X" in the blank before each correct answer.

______a. 6″ × 8″ × 16″

______b. 10″ × 8″ × 16″

______c. 2″ × 2″ × 16″

______d. 4″ × 4″ × 16″ solid

______e. 12″ × 8″ × 8″

______f. 8″ × 8″ × 16″

______g. 4″ × 4″ × 4″

______h. 4″ × 8″ × 16″

## TEST

______i. 12" × 8" × 16"

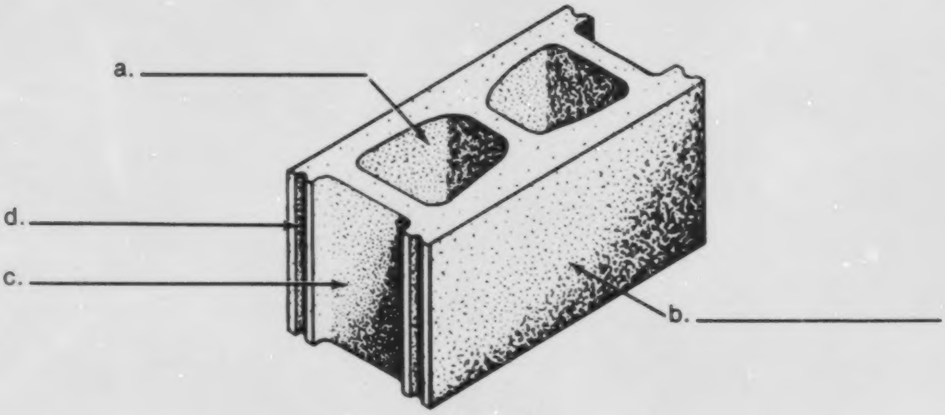
______j. 8" × 8" × 16" solid

______k. 10" × 8" × 8"

______l. 8" × 8"× 8"

______m. 4" × 8" × 8"

13. Label the block below, using the correct nomenclature.



14. State rules to follow when bonding masonry materials.

a. ______________________________________________

b. ______________________________________________

c. ______________________________________________

(NOTE: Test question 15 lists the job sheet. It is an important part of this test. If it has not been completed, check with your instructor.)

15. Demonstrate the ability to lay out a brick wall using dry bond method.

## MASONRY UNITS
## UNIT II

### ANSWERS TO TEST

1.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | 3 | e. | 1 | i. | 2 | m. | 9 |
| b. | 7 | f. | 15 | j. | 8 | n. | 12 |
| c. | 10 | g. | 5 | k. | 11 | o. | 6 |
| d. | 13 | h. | 14 | l. | 4 | | |

2. a. Building brick
   b. Face brick

3.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | 6 | e. | 9 | i. | 16 | m. | 8 |
| b. | 13 | f. | 15 | j. | 10 | n. | 3 |
| c. | 12 | g. | 11 | k. | 2 | o. | 7 |
| d. | 1 | h. | 4 | l. | 14 | p. | 5 |

4. Answer should include any four of the following
   a. Composition
   b. Manufacturing method
   c. Strength
   d. Appearance
   e. Color
   f. Special effects
   g. Economy

5. a. Core
   b. Top
   c. Side

## ANSWERS TO TEST

- d. Bottom
- e. End

6.

| | | | |
|---|---|---|---|
| a. | Shiner | d. | Stretcher |
| b. | Rowlock | e. | Header |
| c. | Sailor | f. | Soldier |

7. Description should include the following
   - a. Hard brick
     - 1) Very dense
     - 2) Low suction or absorption rate
     - 3) Slow setting
   - b. Soft brick
     - 1) Porous
     - 2) High suction or absorption rate
     - 3) Fast setting

8. Answer should include any four of the following
   - a. Color
   - b. Texture
   - c. Size variation
   - d. Absorption rate
   - e. Compressive strength
   - f. Durability

9. a. P
   - b. M
   - c. S

## ANSWERS TO TEST

10. a. Flemish
    b. English
    c. Stack
    d. Common (American)
    e. Running (stretcher)

11. a. Ornamental
    b. Stretcher
    c. Jamb
    d. Conduit
    e. Bond beam
    f. Chimney unit
    g. Pilaster
    h. Corner
    i. Sound absorbing
    j. Control joint
    k. Header
    l. Bullnose
    m. Combination jamb
    n. Return corner

12. a, b, d, e, f, h, i, k, l, m

13. a. Core
    b. Face shell
    c. Cross web
    d. Vertical shell

14. a. Keep bond plumb
    b. Keep walls level with backing material
    c. Maintain set of mortar bond

15. Performance skills evaluated to the satisfaction of the instructor

# ANCHORS AND REINFORCEMENT

## UNIT III

### UNIT OBJECTIVE

After completing this unit, the student should be able to identify anchors and reinforcement and list their uses, set a bearing plate, and install wall ties. The student will show this knowledge by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

### SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with anchors and reinforcement to their correct definitions.
2. List types of anchors and reinforcement used with masonry units.
3. List principal uses for anchors and reinforcement.
4. State advantages of metal ties.
5. Describe spacing for metal ties.
6. State factors to consider when using wall ties in cavity walls.
7. Distinguish among types of anchors and reinforcement.
8. Demonstrate the ability to
    a. Set a bearing plate.
    b. Install wall ties every 16 inches horizontally and vertically on a frame building.

# ANCHORS AND REINFORCEMENT
## UNIT III

## SUGGESTED ACTIVITIES

I. Suggested activities

   A. Obtain transparencies.

      (NOTE: Transparencies are available from AGC and CIMC.)

   B. Gather equipment and materials for job sheet demonstrations.

   C. Provide students with objective sheet.

   D. Discuss unit and specific objectives.

   E. Provide students with information, assignment, and job sheets.

   F. Discuss information and assignment sheets.

   G. Demonstrate and discuss procedures outlined in job sheets.

   H. Provide a variety of anchors and reinforcement so that students may make comparisons and familiarize themselves with these materials.

   I. For cross-reference on anchors and reinforcement, refer to specifications Parts 2.07, 2.08, 2.11, 3.09, 3.10, and 3.15 in "Basic Plan Reading."

   J. Give test.

   K. Complete appropriate section of competency profiles.

      (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM #1 — Anchors and Reinforcement

      2. TM #2 — Anchors and Reinforcement (Continued)

      3. TM #3 — Anchors and Reinforcement (Continued)

      4. TM #4 — Anchors and Reinforcement (Continued)

## SUGGESTED ACTIVITIES

E. Assignment Sheet #1 — Distinguish Among Types of Anchors and Reinforcement

F. Answers to assignment sheet

G. Job sheets

  1. Job Sheet #1 — Set a Bearing Plate, Using Preestablished Reference Marks

  2. Job Sheet #2 — Install Wall Ties Every 16 Inches Horizontally and Vertically on a Frame Building

H. Test

I. Answers to test

III. Unit references

A. Gross, James G., and Harry C. Plummer. *Principles of Clay Masonry Construction,* Student Manual. McLean, Virginia: Brick Institute of America, 1973.

B. Kreh, R.T., Sr. *Masonry Skills.* Albany, New York: Delmar Publishers Inc., 1982.

C. Turcotte, Raymond J. *Bricklaying Curriculum*. Stillwater Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1977.

# ANCHORS AND REINFORCEMENT
## UNIT III

## INFORMATION SHEET

I. Terms and definitions

A. Accessory — Item used to help reinforce and/or anchor masonry units

B. Anchor — Piece or assemblage, usually metal, used to attach building parts to masonry

C. Anchor bolt — Steel bolt installed in masonry to secure a structural member

D. Backup wall — That part of masonry wall behind the exterior facing

E. Bearing plate — Steel plate laid in mortar on masonry walls to provide a solid bed and to distribute weight of beams or joists placed on them

F. Bed joint — Horizontal layer of mortar on which a masonry unit is laid

G. Bond — To tie various parts of masonry wall by overlapping units or by connecting units with metal ties

H. Cavity wall — Wall consisting of inner and outer wythes of masonry units separated by a continuous air space not less than 2 inches wide

I. Composite wall — Any bonded wall consisting of wythes of different masonry units

EXAMPLE: Brick and concrete-block wall

J. Compressive strength — Measured amount of downward pressure that can be applied to a masonry material before it fractures or breaks

K. Lateral pressure — Horizontal component of the force due to a wedge of earth and surcharge, if any, moving or tending to move downward along its natural cleavage plane

L. Load-bearing — Ability of wall or other masonry to support a load in addition to its own weight

M. Reinforcement — Metal bars, wires, or other slender members embedded in concrete so that metal and concrete act together in resisting forces

N. Tensile strength — Measure of a material's ability to withstand stretching

O. Veneer — Protective or ornamental facing not structurally bonded

P. Wall tie — Metal piece that connects wythes of masonry to each other or to other materials

Q. Wythe — Each continuous vertical section of masonry one unit thick

## INFORMATION SHEET

II. Anchors and reinforcement used with masonry units (Transparencies #1-#4; Assignment Sheet #1)

  A. Strap anchor
  B. Cramp anchor
  C. Corrugated wall tie
  D. Strap anchor and dowel
  E. Slotted cramp anchor and wall bolt
  F. Flat-hook wall tie to steel web
  G. Dovetail anchor and slot
  H. Corrugated dovetail anchor
  I. Dovetail anchor and dowel
  J. Two-way dovetail anchor
  K. Eyebolt tieback to steel web
  L. Ring-wedge anchor to steel
  M. Rod cramp anchor
  N. Anchor clip and loop
  O. Rod anchor
  P. Truss tie
  Q. Ladder tie
  R. Adjustable wall ties
  S. Brick and brick
  T. Block and block
  U. Z-tie (with or without drip)
  V. Dovetail anchor
  W. Brick and block
  X. Tab tie (continuous rectangular)

## INFORMATION SHEET

Y. Rectangular tie (with or without drip)

Z. Corrugated veneer tie

AA. Dowel and wire anchor

BB. Power stud anchors (for hard masonry)

CC. Welded bar lugs on shelf-angle support

DD. Ring-wedge anchor for shelf-angle support

EE. Metal doorframe tie

FF. Steel-column anchors

GG. Steel-beam anchors

HH. Anchor bolts

II. Toggle bolts (for block or tile walls)

JJ. Lewis bolt and ring wedge (soffit hanging)

KK. Oblong plate hanger (soffit hanging)

LL. Straps for soffit hanging

MM. Bearing plate

III. Principal uses for anchors and reinforcement

A. Masonry-wall reinforcement

1. Minimizing shrinkage

2. Preventing cracks

3. Strengthening walls

4. Helping control lateral pressure

5. Tying masonry work together

6. Bonding and reinforcing composite and cavity walls

## INFORMATION SHEET

B. Wall ties

1. Tying veneer walls to backup walls
2. Tying veneer to beams and columns
3. Tying cavity walls together
4. Tying masonry to doorframes and window frames

(NOTE: Window-frame and doorframe anchors are usually furnished by the window and door manufacturer.)

IV. Advantages of metal ties

A. Strength

B. Shrinkage control

C. Expansion control

D. Economy

E. Fast installation

V. Spacing for metal ties

A. Reinforcing-type metal ties

1. Use at least one metal tie for every 4½ square feet of wall surface
2. Stagger ties in alternate courses so that no two ties form a continuous vertical line
3. Space ties horizontally no more than 36 inches apart and vertically no more than 16 inches apart
4. Overlap ties at least 6 inches to ensure maximum tensile strength throughout length of bed joint

(NOTE: It is essential that you completely cover the reinforcing material with mortar before laying masonry units on top of it.)

B. Veneer ties

(NOTE: Different architects may specify different spacings for ties.)

1. Never place closer than 1 inch from outside surface of wall
2. Space horizontally and vertically no more than 16 inches apart

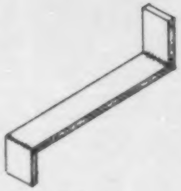
## INFORMATION SHEET

VI. Factors to consider when using wall ties in cavity walls

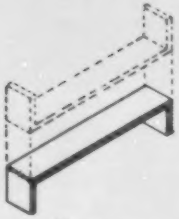
- A. Corrosion resistance
- B. Proper spacing
- C. Proper embedding of ties in mortar
- D. Use of ties with preformed drip crimps

(NOTE: Steel reinforcing ties are acceptable in cavity walls when used with rectangular ties to tie the wall together.)

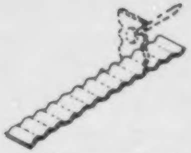
# Anchors and Reinforcement



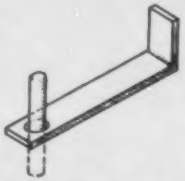
Strap Anchor



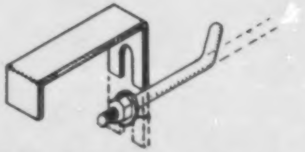
Cramp Anchor



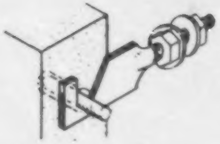
Corrugated Wall Tie



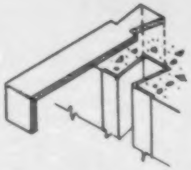
Strap Anchor and Dowel



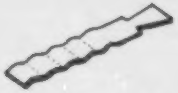
Slotted Cramp Anchor and Wall Bolt



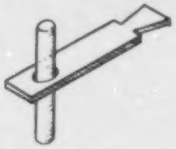
Flat-Hook Wall Tie to Steel Web



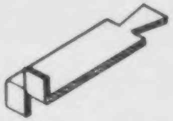
Dovetail Anchor and Slot



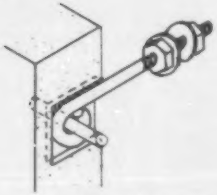
Corrugated Dovetail Anchor



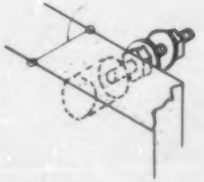
Dovetail Anchor and Dowel



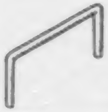
Two-Way Dovetail Anchor



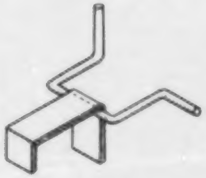
Eyebolt Tieback to Steel Web



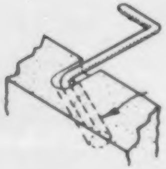
Ring-Wedge Anchor to Steel



Rod Cramp Anchor



Anchor Clip and Loop



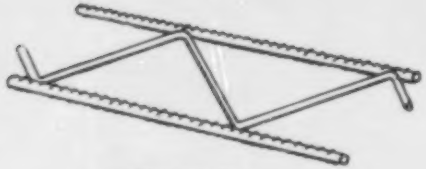
Rod Anchor

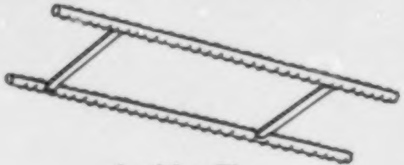
TM #1

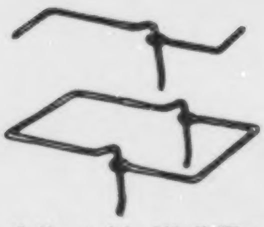
PBL - 85-B

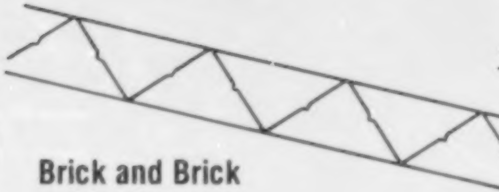
# Anchors and Reinforcement

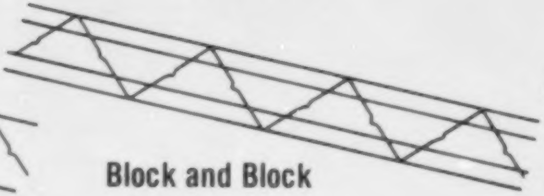
(Continued)

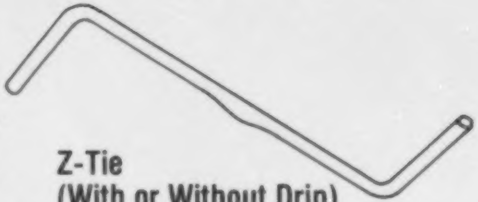

Truss Tie

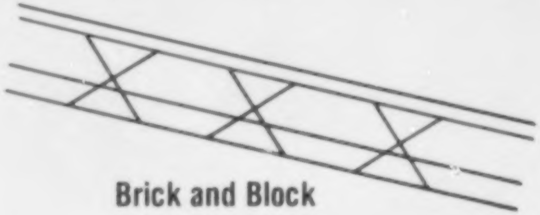

Ladder Tie

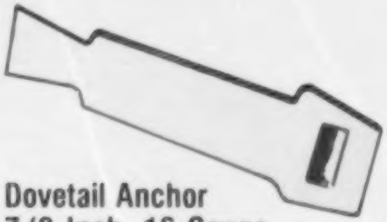

Adjustable Wall Ties

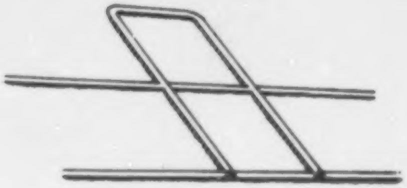

Brick and Brick

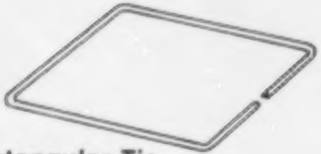

Block and Block

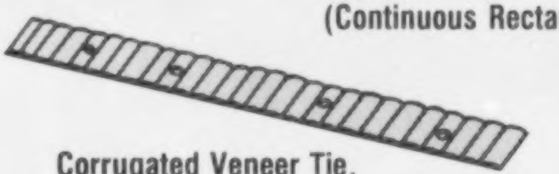

Z-Tie
(With or Without Drip)


Brick and Block


Dovetail Anchor
7/8-Inch, 16-Gauge


Tab Tie
(Continuous Rectangular)


Rectangular Tie
(With or Without Drip)

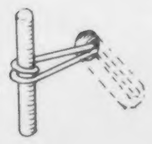

Corrugated Veneer Tie,
7/8-Inch, 22-Gauge

TM #2

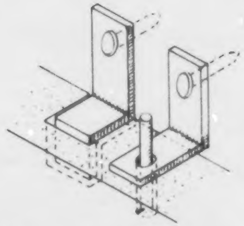
PBL - 87-B

# Anchors and Reinforcement

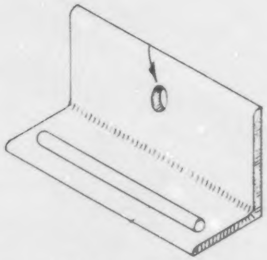
(Continued)



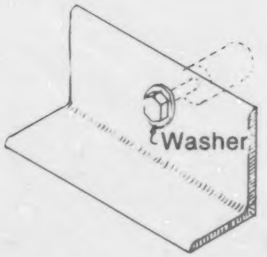
**Dowel and Wire Anchor**



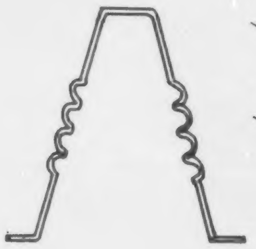
**Power Stud Anchors (For Hard Masonry)**



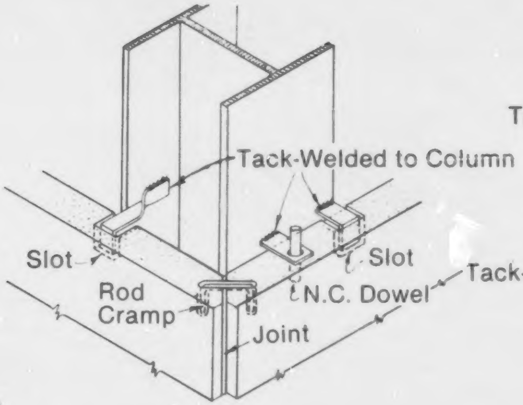
**Welded Bar Lugs on Shelf-Angle Support**



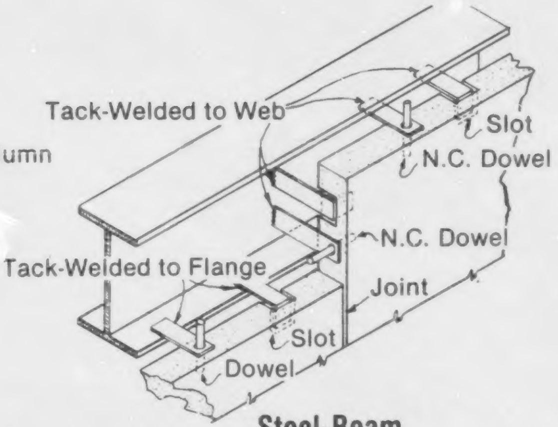
**Ring-Wedge Anchor for Shelf-Angle Support**



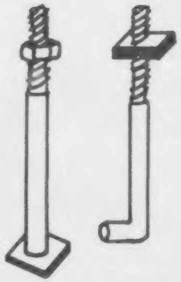
**Metal Doorframe Tie**


Tack-Welded to Column
Slot
Slot
Rod Cramp
N.C. Dowel
Joint

**Steel-Column Anchors**


Tack-Welded to Web
Slot
N.C. Dowel
N.C. Dowel
Tack-Welded to Flange
Joint
Slot
Dowel

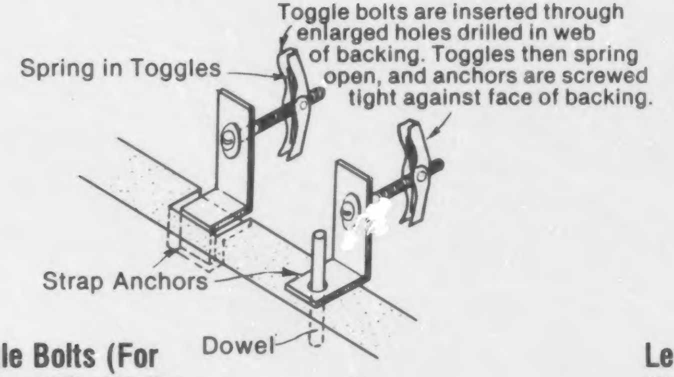
**Steel-Beam Anchors**



**Anchor Bolts**

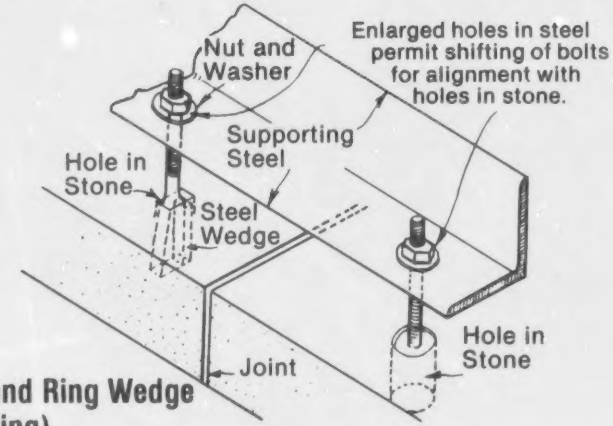
# Anchors and Reinforcement

(Continued)


Spring in Toggles
Strap Anchors
Dowel

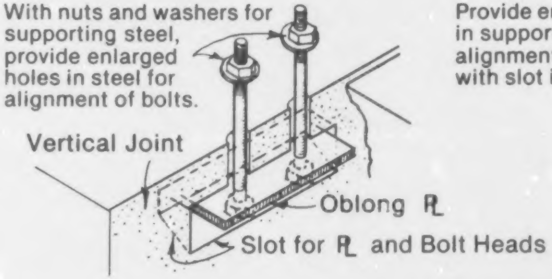
Toggle bolts are inserted through enlarged holes drilled in web of backing. Toggles then spring open, and anchors are screwed tight against face of backing.

**Toggle Bolts (For Block or Tile Walls)**


Nut and Washer
Supporting Steel
Hole in Stone
Steel Wedge
Hole in Stone
Joint

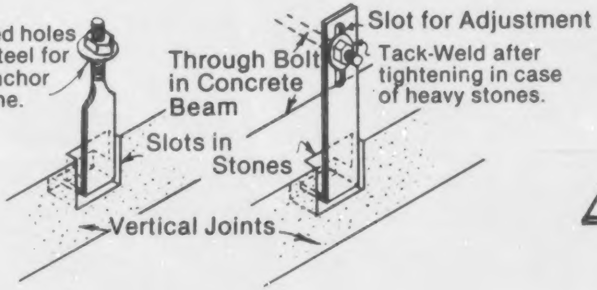
Enlarged holes in steel permit shifting of bolts for alignment with holes in stone.

**Lewis Bolt and Ring Wedge (Soffit Hanging)**


Vertical Joint
Oblong PL
Slot for PL and Bolt Heads

With nuts and washers for supporting steel, provide enlarged holes in steel for alignment of bolts.

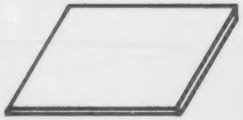
**Oblong Plate Hanger (Soffit Hanging)**


Slot for Adjustment
Through Bolt in Concrete Beam
Slots in Stones
Vertical Joints

Provide enlarged holes in supporting steel for alignment of anchor with slot in stone.

Tack-Weld after tightening in case of heavy stones.

**Straps for Soffit Hanging**



**Bearing Plate**

# ANCHORS AND REINFORCEMENT
## UNIT III

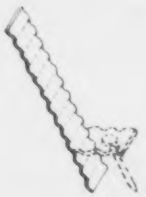
## ASSIGNMENT SHEET #1 — DISTINGUISH AMONG TYPES OF ANCHORS AND REINFORCEMENT

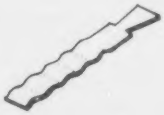
NAME ______________________________ SCORE ____________

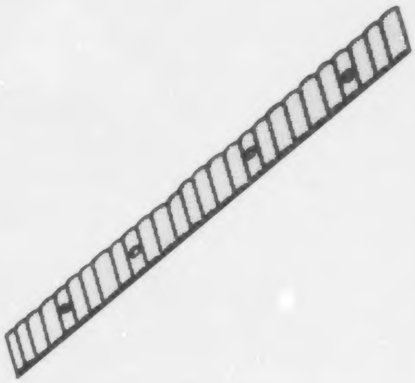
Distinguishing among accessories will help you recognize and familiarize yourself with the different types of anchors and reinforcing materials available to the bricklayer.

Distinguish among types of accessories. Write an "X" in the blank under each correct illustration.

A. Corrugated veneer tie

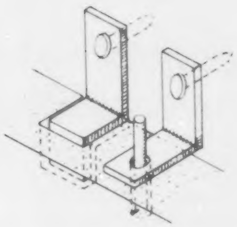


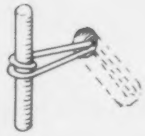


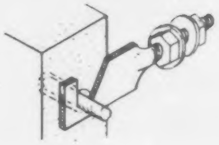


1. ____________ 2. ____________ 3. ____________

B. Power stud anchor



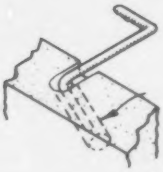
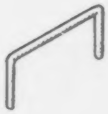
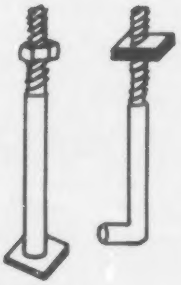




1. ____________ 2. ____________ 3. ____________

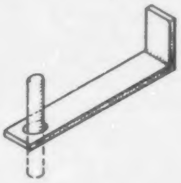
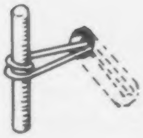
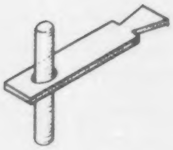
## ASSIGNMENT SHEET #1

C. Rod anchor

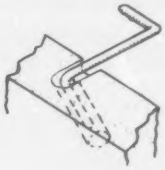
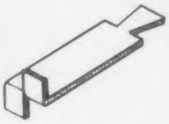
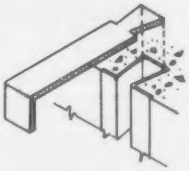
1. ____________ 2. ____________ 3. ____________

D. Dovetail anchor and dowel

1. ____________ 2. ____________ 3. ____________

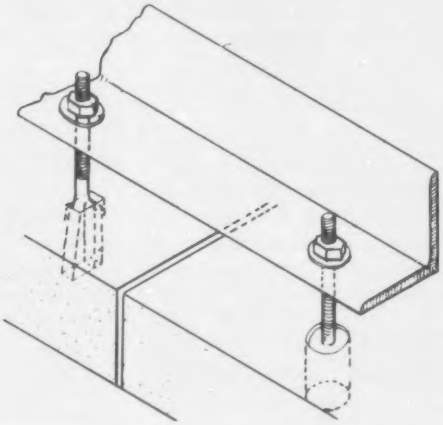
E. Two-way dovetail anchor

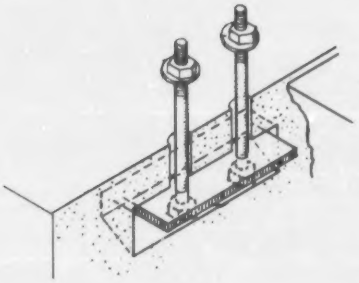




1. ____________ 2. ____________ 3. ____________

## ASSIGNMENT SHEET #1

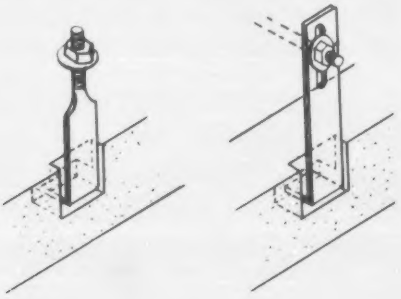
F. Oblong plate hanger

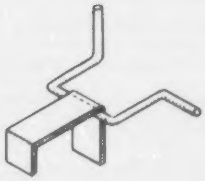




1. ______________________________ 2. ______________________________

G. Strap for soffit hanging

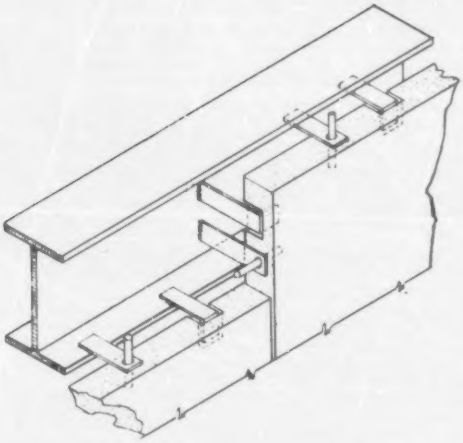




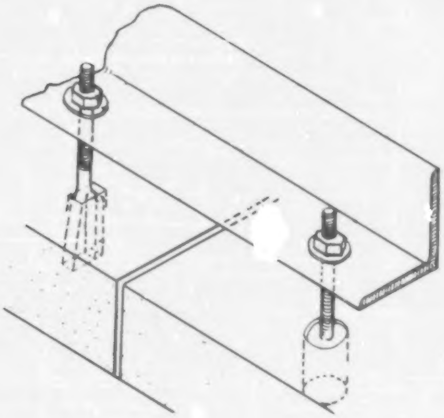
1. ______________________________ 2. ______________________________

## ASSIGNMENT SHEET #1

H. Steel-beam anchor

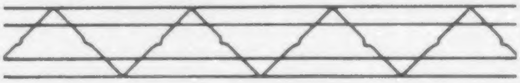


1. ______________________________

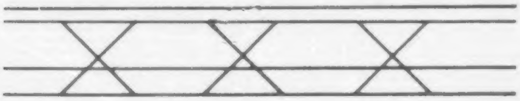


2. ______________________________

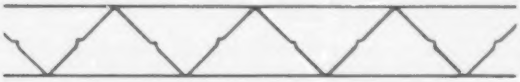
I. Brick and block



1. ______________________________



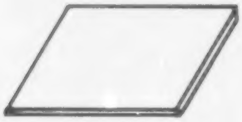
2. ______________________________

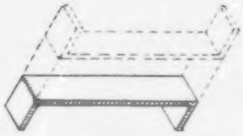


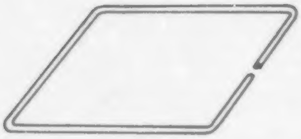
3. ______________________________

## ASSIGNMENT SHEET #1

J. Rectangular tie

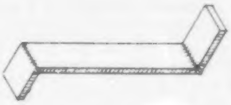


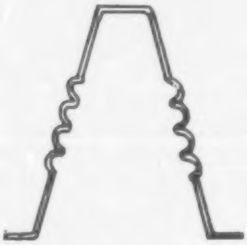


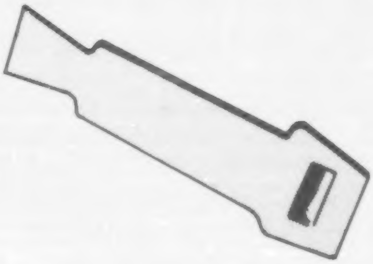


1. ________________ 2. ________________ 3. ________________

K. Strap anchor

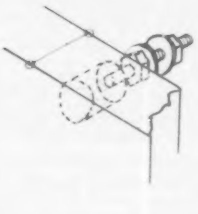


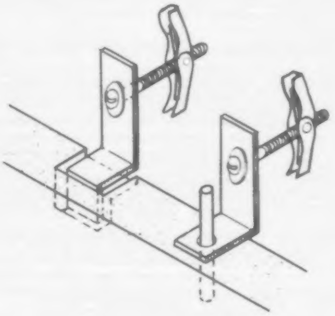


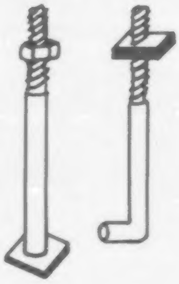


1. ________________ 2. ________________ 3. ________________

L. Toggle bolt



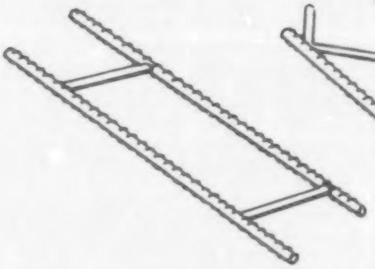


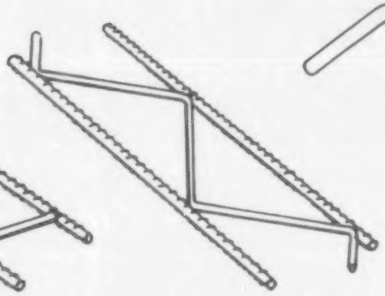


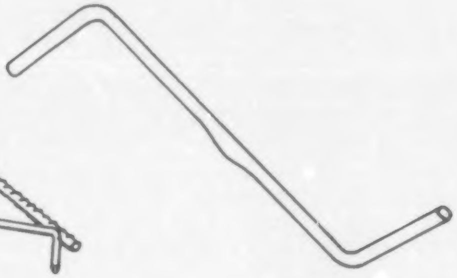
1. ________________ 2. ________________ 3. ________________

## ASSIGNMENT SHEET #1

M. Truss tie

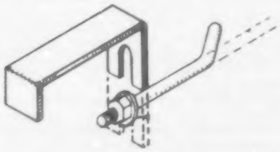


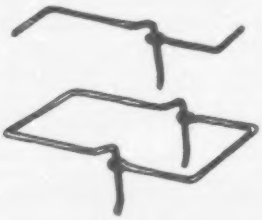


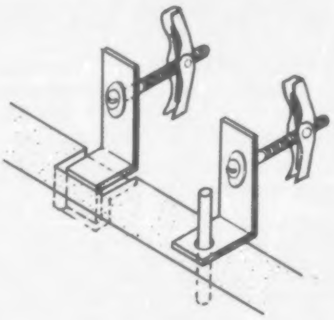


1. ________________ 2. ________________ 3. ________________

N. Adjustable wall tie

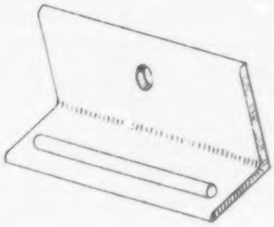


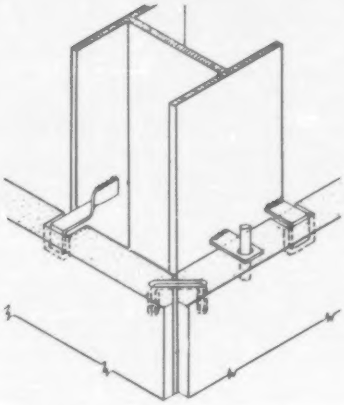


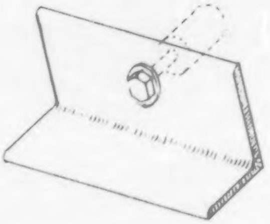


1. ________________ 2. ________________ 3. ________________

O. Steel-column anchor



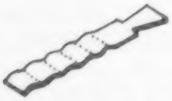


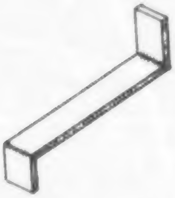


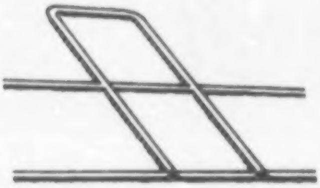
1. ________________ 2. ________________ 3. ________________

## ASSIGNMENT SHEET #1

P. Tab tie

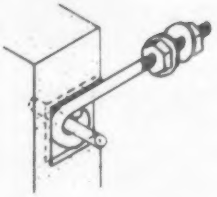


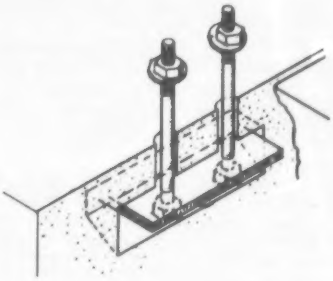


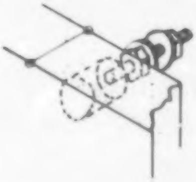


1. ____________________ 2. ____________________ 3. ____________________

Q. Eyebolt tieback to steel web

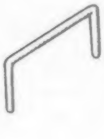


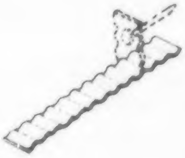


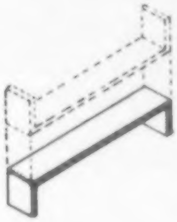


1. ____________________ 2. ____________________ 3. ____________________

R. Cramp anchor



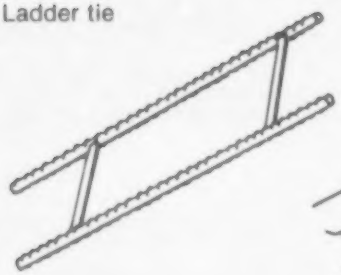




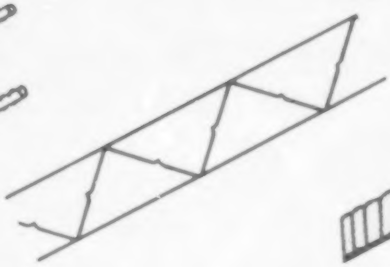
1. ____________________ 2. ____________________ 3. ____________________

## ASSIGNMENT SHEET #1

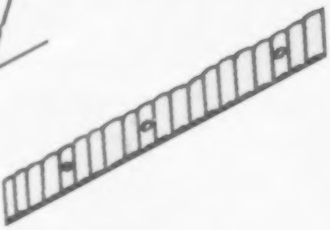
S. Ladder tie



1. ____________________



2. ____________________



3. ____________________

# ANCHORS AND REINFORCEMENT
## UNIT III

## ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A. | 3 | F. | 2 | K. | 1 | P. | 3 |
| B. | 1 | G. | 1 | L. | 2 | Q. | 1 |
| C. | 1 | H. | 1 | M. | 2 | R. | 3 |
| D. | 3 | I. | 2 | N. | 2 | S. | 1 |
| E. | 2 | J. | 3 | O. | 2 | | |

# ANCHORS AND REINFORCEMENT
## UNIT III

## JOB SHEET #1 — SET A BEARING PLATE, USING PREESTABLISHED REFERENCE MARKS

I. Equipment and materials

  A. Brick trowel

  B. Level

  C. Hammer

  D. Rule

  E. Steel plate

  F. Mortar

II. Procedure

  A. Clean off area for steel plate

  B. Spread mortar on area

  (NOTE: Always spread more mortar than is needed to assure proper seating of the plate and to eliminate any voids under the plate.)

  C. Place steel plate on mortar bed

  D. Tap plate down gently with hammer handle

  E. Check to see that top of steel plate is level with reference mark

  (NOTE: Reference marks are already established. Steel plates are sometimes set with leveling instruments.)

  F. Place level on plate; adjust plate for proper level

  G. Turn level 90 degrees on plate; adjust plate for proper level

  H. Turn level back again 90 degrees to original position to be sure that levelness of plate was not changed

  I. Clean work area; put away equipment and materials

# ANCHORS AND REINFORCEMENT
## UNIT III

## JOB SHEET #2 — INSTALL WALL TIES EVERY 16 INCHES HORIZONTALLY AND VERTICALLY ON A FRAME BUILDING

I. Equipment and materials

- A. Hammer
- B. Rule or tape
- C. Chalk box and chalk line
- D. Ties
- E. Nails

II. Procedure

- A. Start at one end of building and measure up the wall, making a mark every 16 inches
- B. Repeat process at opposite end of building

  (NOTE: If wall is over 20 feet long, mark center of wall also.)
- C. Use chalk line to snap horizontal lines from one mark to the other
- D. Start at one end, and nail ties to wall where horizontal chalk line crosses stud

  (NOTE: Because most studs in frame buildings are centered every 16 inches, these are your vertical guides for nailing the ties.)
- E. Continue nailing the wall ties until you have nailed one every 16 inches both horizontally and vertically

  (NOTE: Not all ties will be nailed on 16-inch centers. Tie spacing depends on architect's specifications.)
- F. Clean work area; put away equipment and materials

## ANCHORS AND REINFORCEMENT
## UNIT III

## TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with anchors and reinforcement to their correct definitions. Write the correct numbers in the blanks. Terms and definitions continue on the following page.

______a. Protective or ornamental facing not structurally bonded

______b. Horizontal layer of mortar on which a masonry unit is laid

______c. Steel bolt installed in masonry to secure a structural member

______d. To tie various parts of masonry wall by overlapping units or by connecting units with metal ties

______e. Metal piece that connects wythes of masonry to each other or to other materials

______f. Wall consisting of inner and outer wythes of masonry units separated by a continuous air space not less than 2 inches wide

______g. That part of masonry wall behind the exterior facing

______h. Each continuous vertical section of masonry one unit thick

______i. Item used to help reinforce and/or anchor masonry units

______j. Measured amount of downward pressure that can be applied to a masonry material before it fractures or breaks

______k. Steel plate laid in mortar on masonry walls to provide a solid bed and to distribute weight of beams or joists placed on them

______l. Ability of wall or other masonry to support a load in addition to its own weight

1. Load-bearing
2. Bond
3. Compressive strength
4. Wythe
5. Cavity wall
6. Bearing plate
7. Anchor bolt
8. Bed joint
9. Accessory
10. Veneer
11. Backup wall
12. Wall tie

## TEST

______m. Piece or assemblage, usually metal, used to attach building parts to masonry

______n. Any bonded wall consisting of wythes of different masonry units

______o. Measure of a material's ability to withstand stretching

______p. Horizontal component of the force due to a wedge of earth and surcharge, if any, moving or tending to move downward along its natural cleavage plane

______q. Metal bars, wires, or other slender members embedded in concrete so that metal and concrete act together in resisting forces

13. Composite wall
14. Lateral pressure
15. Anchor
16. Tensile strength
17. Reinforcement

2. List twenty types of anchors and reinforcement used with masonry units.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

k. ______________________________

l. ______________________________

m. ______________________________

n. ______________________________

## TEST

o. ______________________________

p. ______________________________

q. ______________________________

r. ______________________________

s. ______________________________

t. ______________________________

3. List three principal uses each for anchors and reinforcement.

   a. Masonry-wall reinforcement

      1) ______________________________

      2) ______________________________

      3) ______________________________

   b. Wall ties

      1) ______________________________

      2) ______________________________

      3) ______________________________

4. State three advantages of metal ties.

   a. ______________________________

   b. ______________________________

   c. ______________________________

5. Describe spacing for metal ties.

   a. Reinforcing-type metal ties

      ______________________________

      ______________________________

      ______________________________

      ______________________________

## TEST

b. Veneer ties

______________________________________________

______________________________________________

6. State three factors to consider when using wall ties in cavity walls.

a. ______________________________________________

b. ______________________________________________

c. ______________________________________________

(NOTE: Test questions 7 and 8 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

7. Distinguish among types of anchors and reinforcement.

8. Demonstrate the ability to

   a. Set a bearing plate.

   b. Install wall ties every 16 inches horizontally and vertically on a frame building.

## ANCHORS AND REINFORCEMENT
## UNIT III

## ANSWERS TO TEST

1. a. 10
   b. 8
   c. 7
   d. 2
   e. 12
   f. 5
   g. 11
   h. 4
   i. 9
   j. 3
   k. 6
   l. 1
   m. 15
   n. 13
   o. 16
   p. 14
   q. 17

2. Answer should include any twenty of the following
   a. Strap anchor
   b. Cramp anchor
   c. Corrugated wall tie
   d. Strap anchor and dowel
   e. Slotted cramp anchor and wall bolt
   f. Flat-hook wall tie to steel web
   g. Dovetail anchor and slot
   h. Corrugated dovetail anchor
   i. Dovetail anchor and dowel
   j. Two-way dovetail anchor
   k. Eyebolt tieback to steel web
   l. Ring-wedge anchor to steel
   m. Rod cramp anchor
   n. Anchor clip and loop
   o. Rod anchor
   p. Truss tie

## ANSWERS TO TEST

q. Ladder tie

r. Adjustable wall ties

s. Brick and brick

t. Block and block

u. Z-tie (with or without drip)

v. Dovetail anchor

w. Brick and block

x. Tab tie (continuous rectangular)

y. Rectangular tie (with or without drip)

z. Corrugated veneer tie

aa. Dowel and wire anchor

bb. Power stud anchors (for hard masonry)

cc. Welded bar lugs on shelf-angle support

dd. Ring-wedge anchor for shelf-angle support

ee. Metal doorframe tie

ff. Steel-column anchors

gg. Steel-beam anchors

hh. Anchor bolts

ii. Toggle bolts (for block or tile walls)

jj. Lewis bolt and ring wedge (soffit hanging)

kk. Oblong plate hanger (soffit hanging)

ll. Straps for soffit hanging

mm. Bearing plate

## ANSWERS TO TEST

3. Answer should include any three of the following for each type of anchor or reinforcement

    a. Masonry-wall reinforcement

        1) Minimizing shrinkage

        2) Preventing cracks

        3) Strengthening walls

        4) Helping control lateral pressure

        5) Tying masonry work together

        6) Bonding and reinforcing composite and cavity walls

    b. Wall ties

        1) Tying veneer walls to backup walls

        2) Tying veneer to beams and columns

        3) Tying cavity walls together

        4) Tying masonry to doorframes and window frames

4. Answer should include any three of the following

    a. Strength

    b. Shrinkage control

    c. Expansion control

    d. Economy

    e. Fast installation

5. Description should include the following

    a. Reinforcing-type metal ties

        1) Use at least one metal tie for every 4½ square feet of wall surface

        2) Stagger ties in alternate courses so that no two ties form a continuous vertical line

        3) Space ties horizontally no more than 36 inches apart and vertically no more than 16 inches apart

        4) Overlap ties at least 6 inches to ensure maximum tensile strength throughout length of bed joint

## ANSWERS TO TEST

- b. Veneer ties
  - 1) Never place closer than 1 inch from outside surface of wall
  - 2) Space horizontally and vertically no more than 16 inches apart

6. Answer should include any three of the following
   - a. Corrosion resistance
   - b. Proper spacing
   - c. Proper embedding of ties in mortar
   - d. Use of ties with preformed drip crimps

7. Evaluated to the satisfaction of the instructor

8. Performance skills evaluated to the satisfaction of the instructor

# WALL LAYOUT
## UNIT I

## UNIT OBJECTIVE

After completing this unit, the student should be able to lay out and construct walls. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with wall layout to their correct definitions.
2. State the purposes of wall layout.
3. Arrange in order the procedures for laying out a wall.
4. Discuss the purposes of laying out brick bonds.
5. Name methods of layout.
6. Discuss purposes of bonds.
7. Label types of wall bonds.
8. Label types of paving or panel bonds.
9. Distinguish between load-bearing and non-load-bearing walls.
10. State purpose of through-wall bonding.
11. Label types of through-wall bonding.
12. State the purposes of grouting.
13. List types of reinforcement.
14. State purposes of leads.
15. Name types of leads.
16. Demonstrate the ability to
    a. Lay out and construct a section of wall containing joint reinforcement.
    b. Lay out and construct a section of wall containing openings and joint reinforcement.

# WALL LAYOUT
# UNIT I

## SUGGESTED ACTIVITIES

I. Suggested activities

   A. Make or obtain transparencies.

      (NOTE: Transparencies are available from AGC and CIMC.)

   B. Provide students with objective sheet.

   C. Discuss unit and specific objectives.

   D. Provide students with information and job sheets.

   E. Discuss information sheet.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. For cross reference on layout, refer to specifications Parts 3.19, 3.20, and 3.23 in "Basic Plan Reading" of *Bricklaying: Basic Core.*

   H. Furnish specifications to students so that they may accomplish procedures outlined in job sheets.

   I. Give test.

   J. Complete appropriate section of competency profiles.

      (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM #1 — Methods of Layout (Brick)

      2. TM #2 — Methods of Layout (Block)

      3. TM #3 — Types of Block Wall Bonds

      4. TM #4 — Types of Leads (Brick)

      5. TM #5 — Types of Leads (Block)

## SUGGESTED ACTIVITIES

E. Job sheets

   1. Job Sheet #1 — Lay Out and Construct a Section of Wall Containing Joint Reinforcement

   2. Job Sheet #2 — Lay Out and Construct a Section of Wall Containing Openings and Joint Reinforcement

F. Test

G. Answers to test

III. Unit references

A. Graham, Frank D. *Audel's Masons and Builders Guide*, Vol. 1. Indianapolis: Theodore Audel and Co./Howard W. Sams and Co., Inc., 1961.

B. Hendrix, Laborn J. "Bud," and Bob Patton. *Cement Mason's Curriculum*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1975.

C. Kreh, R.T., Sr. *Masonry Skills*. Albany, New York: Delmar Publishers, Inc., 1982.

D. Roark, William F., and Harry C. Plummer. *Bricklaying Vocational Training*. McLean, Virginia: Brick Institute of America, 1973.

E. Turcotte, Raymond J. *Bricklaying*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1977.

# WALL LAYOUT
# UNIT I

## INFORMATION SHEET

I. Terms and definitions

A. Brick bond — Pattern in which bricks are laid

B. Cavity — Air space or opening between two wythes of masonry units

C. Dry bond — Method of determining brick bond by laying brick without mortar

D. Grout — Thin mixture of mortar; poured into wall cavity for bonding purposes

E. Grouted masonry — Masonry in which the cavity is filled with grout

F. Keel — Construction crayon

G. Lead — Section of wall built up and racked back on successive courses

H. Lintel — Horizontal member placed over wall openings to support the weight of masonry above

I. Load-bearing wall — Wall that not only supports itself but the structure above

J. Non-load-bearing wall — Wall that supports only its own weight

K. Parging — Plastering of masonry walls with mortar

L. Rack — To set back the end of each course from the end of preceding course

M. Reinforced masonry — Unit of masonry in which reinforcement is embedded to give additional strength to wall

N. Scaffold — Temporary structure or platform to support workers and material during construction

O. Scaffold-high — High enough to use a scaffold to continue construction

P. Story pole — Length of wood marked for course levels and/or heights and openings

Q. Strike — To tool joints

R. Through-wall bonding — Method of bonding by joining outer and inner walls

S. Wythe — Continuous section of masonry one unit in thickness

# INFORMATION SHEET

II. Purposes of wall layout

   A. Establishing wall locations

   B. Establishing bonds

   C. Establishing openings

   D. Establishing elevations

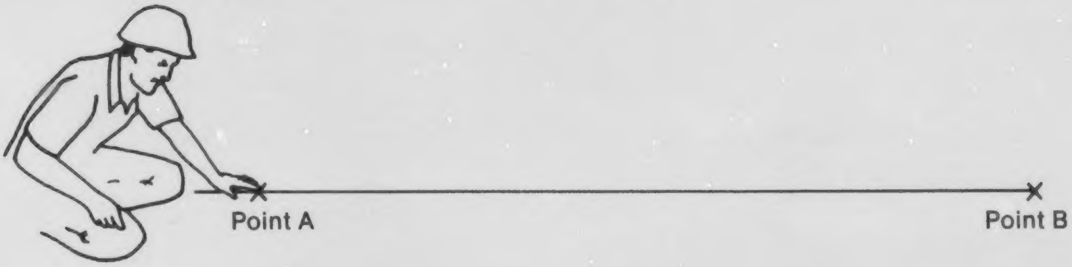
III. Procedures for laying out a wall

   A. Locate reference points (A and B) for wall line

   B. Snap a chalk line from point A to point B (Figure 1)

   EXAMPLE:

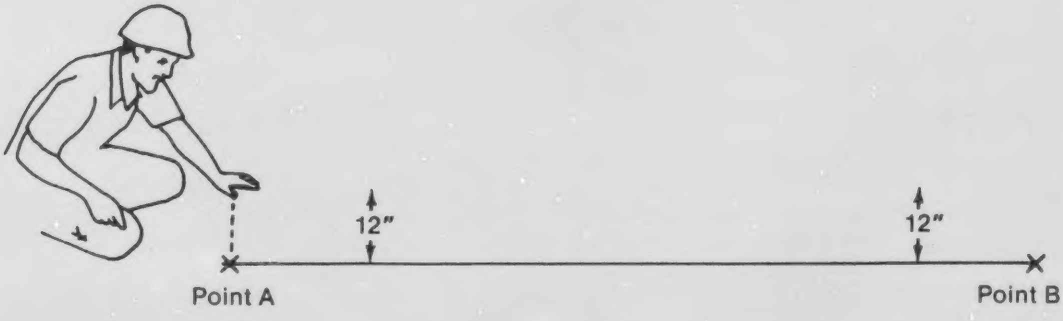
FIGURE 1



   C. Establish opposite side of wall by marking points on a line parallel to chalk line by a distance of proposed wall thickness (Figure 2)

   EXAMPLE:

FIGURE 2



## INFORMATION SHEET

D. Snap a chalk line between these two new points

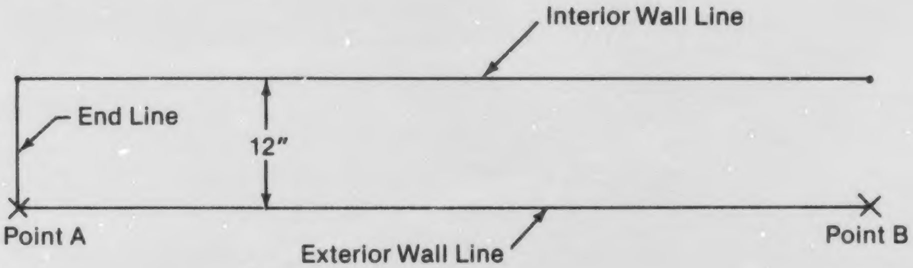
(NOTE: These two chalk lines should be parallel to each other.)

E. Use framing square to square from point A across to second line (Figure 3)

(NOTE: This will establish end of wall and starting point for first unit.)

EXAMPLE:

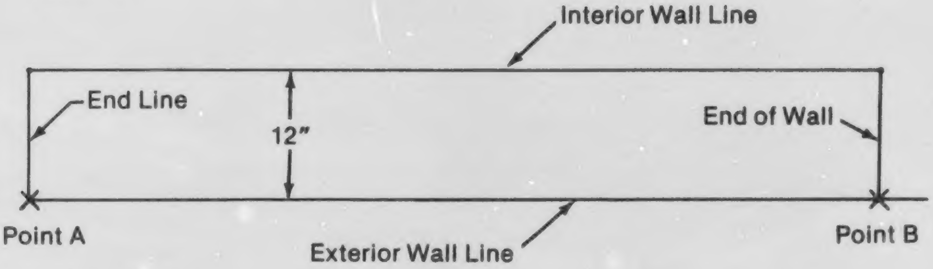
FIGURE 3


Interior Wall Line
End Line
12"
Point A
Exterior Wall Line
Point B

F. Measure from point A (starting point) to end of wall; square a mark at this point (Figure 4)

EXAMPLE:

FIGURE 4


Interior Wall Line
End Line
12"
End of Wall
Point A
Exterior Wall Line
Point B

IV. Purposes of laying out brick bonds

A. Establishing in place and marking position of each brick of first course to ensure a true bond

B. Locating all openings so that bond can be regulated or fitted to dimensions called for on plans

## INFORMATION SHEET

V. Methods of layout (Transparencies #1 and #2)

- A. Dry bonding
- B. Steel tape bonding

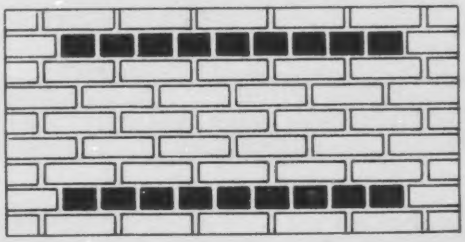
VI. Purposes of bonds

- A. Adding strength and rigidity to the wall
- B. Beautifying through design and economy of design

VII. Types of wall bonds (Figures 5-12; Transparency #3)

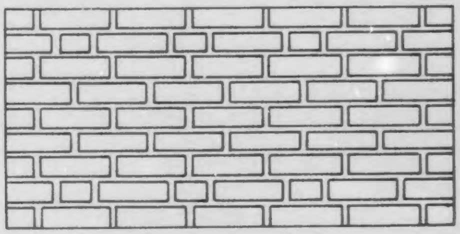
- A. Common or full header

FIGURE 5



- B. Common or Flemish header

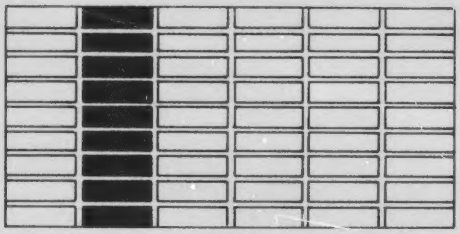
FIGURE 6



## INFORMATION SHEET

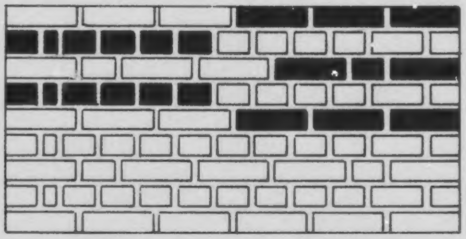
C. Stack

FIGURE 7



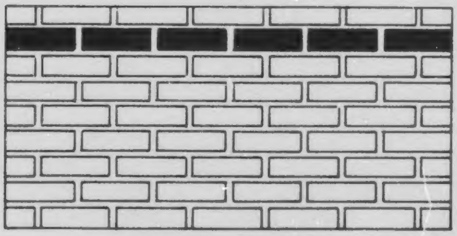
D. English cross or Dutch

FIGURE 8



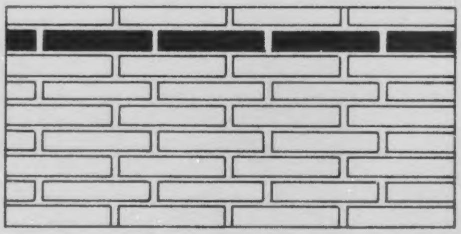
E. Running

FIGURE 9



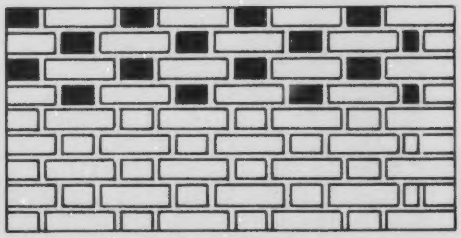
F. One-third running

FIGURE 10



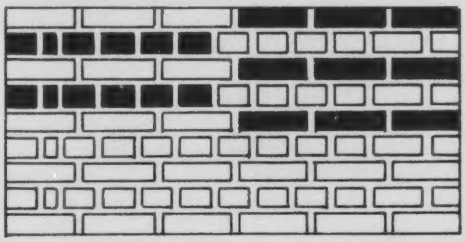
G. Flemish

FIGURE 11



H. English

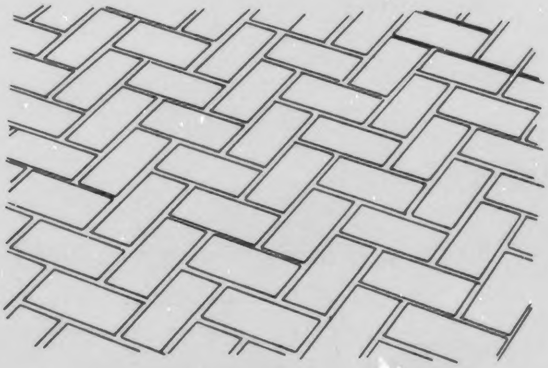
FIGURE 12



VIII. Types of paving or panel bonds (Figures 13-16)

A. Herringbone flat

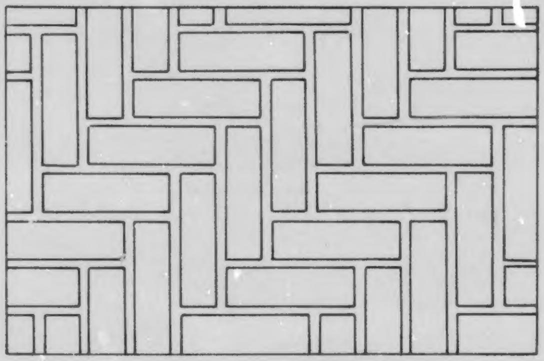
FIGURE 13



## INFORMATION SHEET

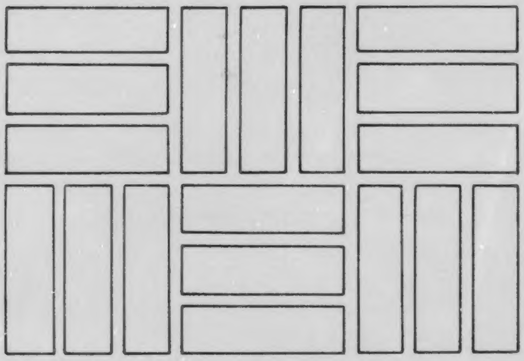
B. Herringbone regular (on edge)

FIGURE 14



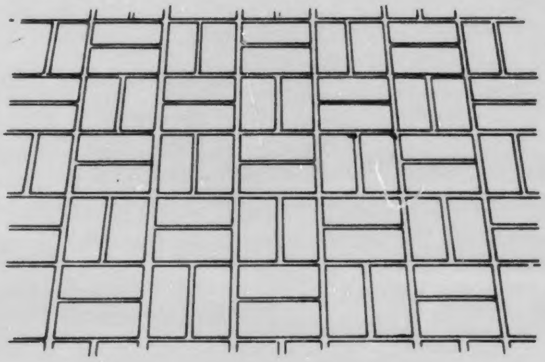
C. Basket weave on edge

FIGURE 15



D. Basket weave flat

FIGURE 16

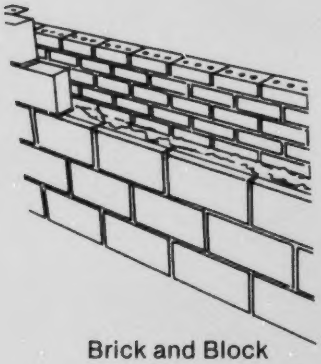


## INFORMATION SHEET

IX. Load-bearing and non-load-bearing walls

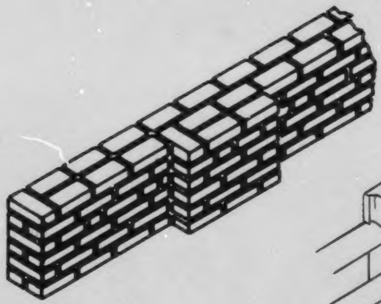
A. Load-bearing (Figures 17-19)

FIGURE 17



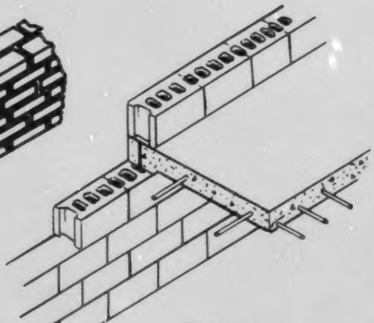
Brick and Block

FIGURE 18



Brick

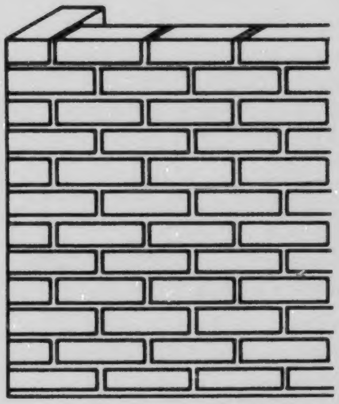
FIGURE 19



Block

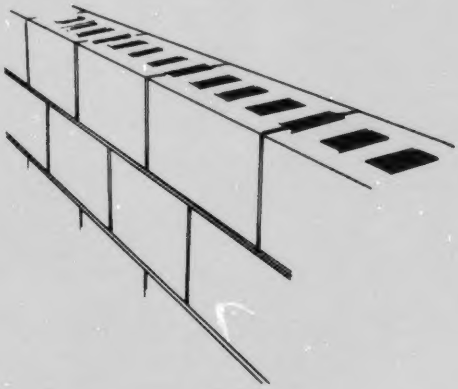
B. Non-load-bearing (Figures 20 and 21)

FIGURE 20



Brick

FIGURE 21



Block

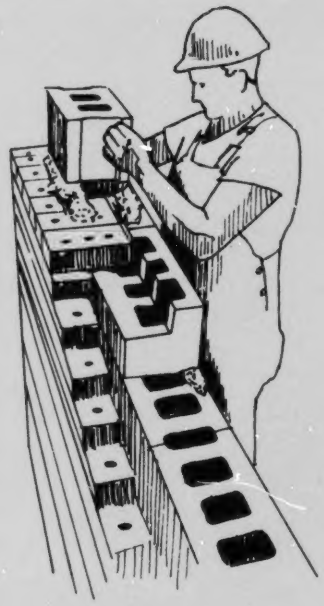
X. Purpose of through-wall bonding — Joining outer and inner wythes to strengthen wall

## INFORMATION SHEET

XI. Types of through-wall bonding (Figures 22-24)

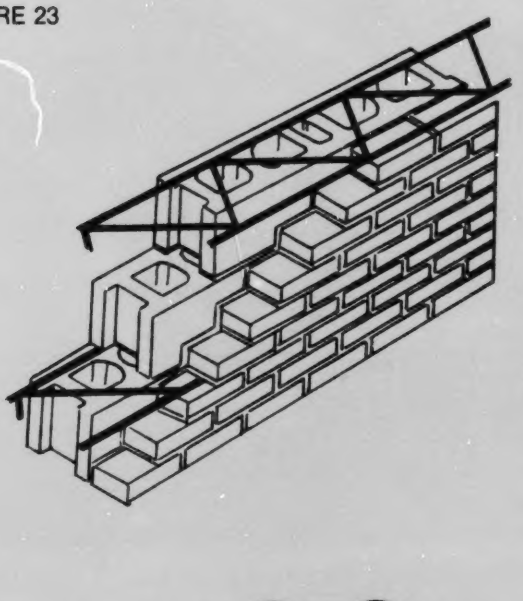
A. Header construction

FIGURE 22



B. Joint reinforcement or heavy-gauge ties

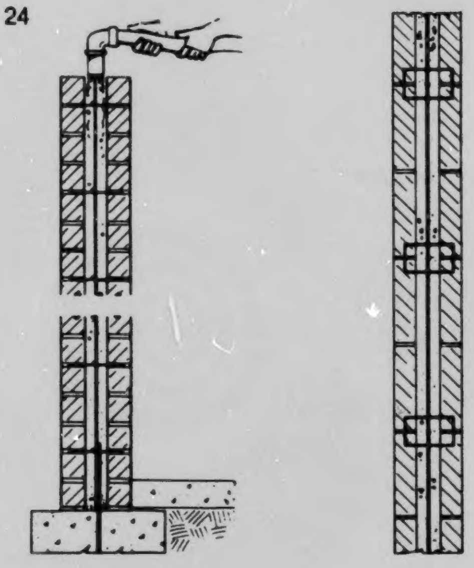
FIGURE 23



## INFORMATION SHEET

C. Grouting and reinforcement

FIGURE 24



XII. Purposes of grouting

A. Providing greater strength in masonry

B. Forming a single unit of construction to resist forces

XIII. Types of reinforcement

A. Grout/steel

1. Low-lift grout used with reinforcing steel

(NOTE: One wythe of wall is laid to a height of approximately 12 inches. The other wythe is laid one course higher, then grout is poured into the cavity to a level 3/4 inch from the top.)

2. High-lift grout used with reinforcing steel

(NOTE: Wall is built to specified height not over 9 feet high, then grout is poured or pumped in layers 4 feet or less into cavity.)

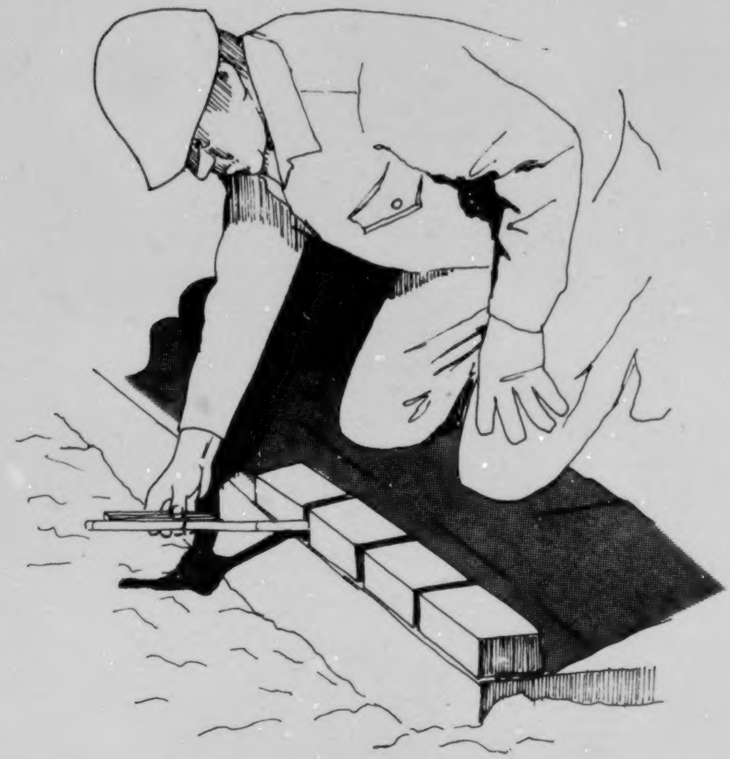
## INFORMATION SHEET

B. Reinforcing steel
  1. Reinforcing bars
  2. Metal lath
  3. Wire screen
  4. Reinforcing wire

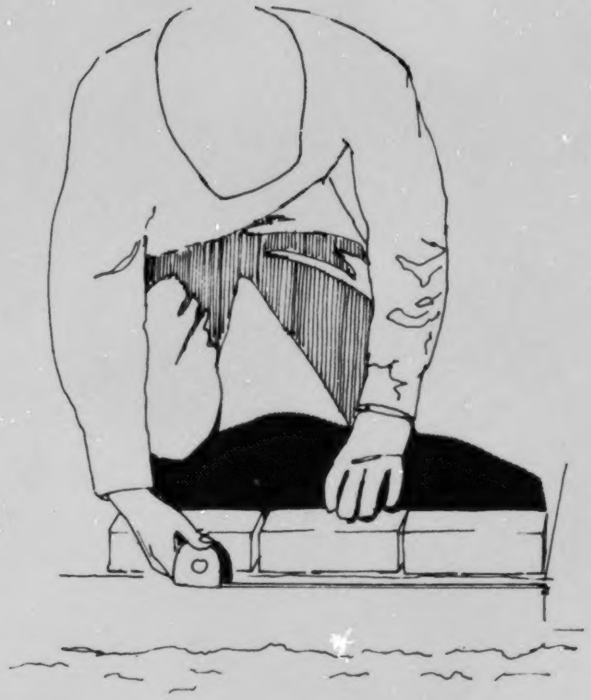
XIV. Purposes of leads
  A. Maintaining proper elevation
  B. Establishing wall pattern
  C. Acting as a guide for wall construction

XV. Types of leads (Transparencies #4 and #5)
  A. Outside corner
  B. Angle or inside corner
  C. Rack back
  D. Corner pole

# Methods of Layout
# (Brick)

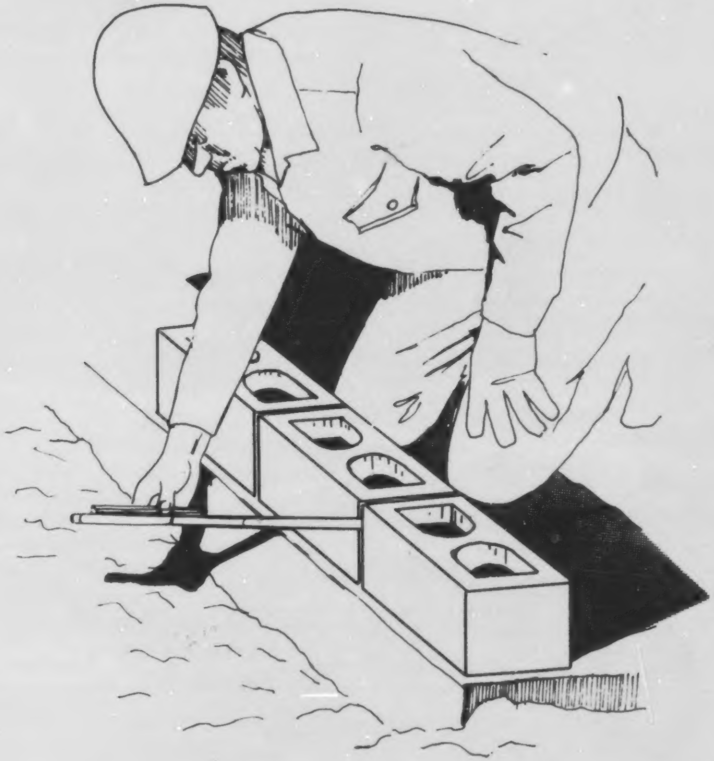


Dry Bonding

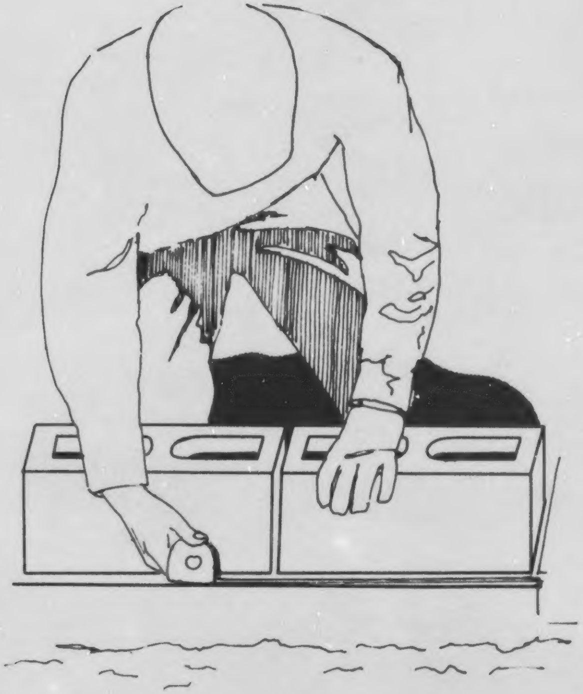


Steel Tape Bonding

# Methods of Layout (Block)



Dry Bonding



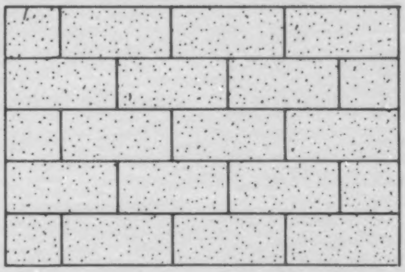
Steel Tape Bonding

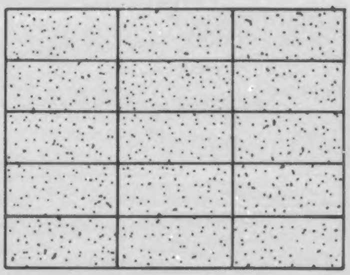
TM #2

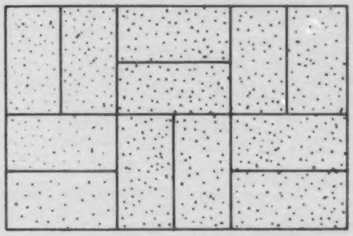
PBL - 19-C

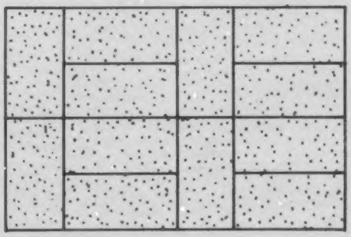
PBL - 21-C

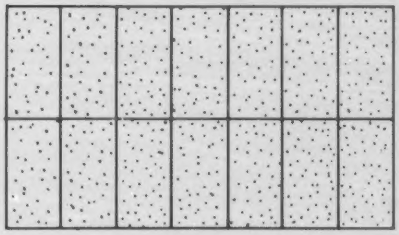
# Types of Block Wall Bonds

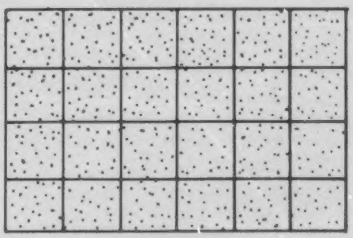

Running

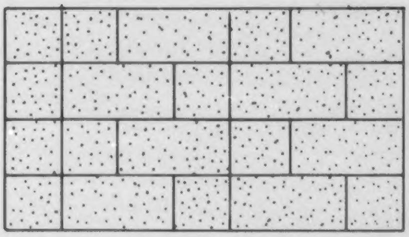

Horizontal Stack

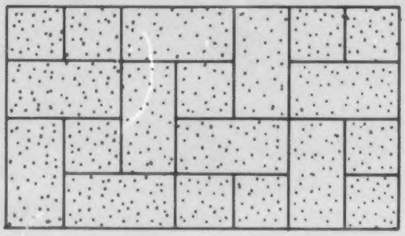

Basket Weave


Basket Weave


Vertical Stacking

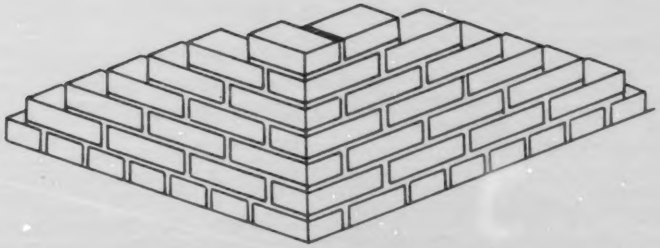

Half Stack or Square Stack


Patterned Ashlar

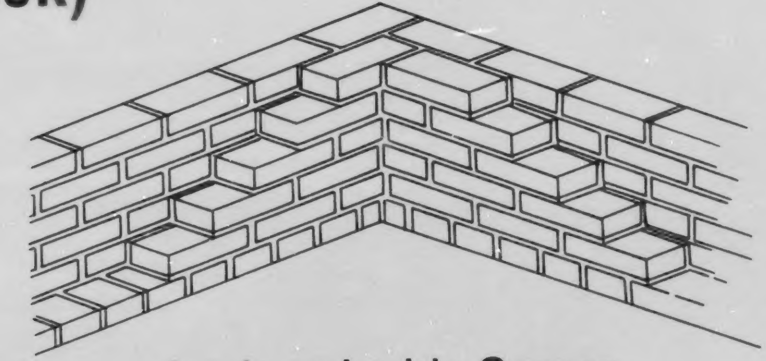

Patterned Ashlar

TM #3

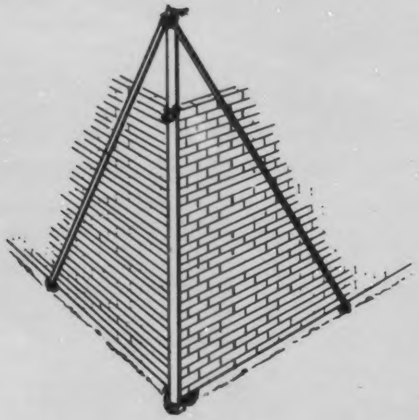
# Types of Leads
(Brick)



Outside Corner



Angle or Inside Corner

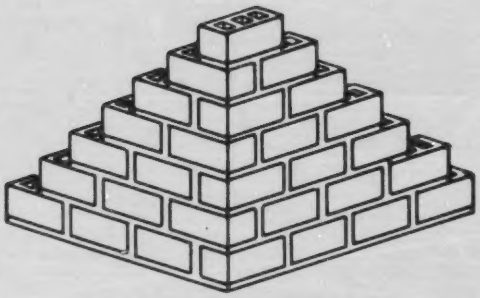


Corner Pole

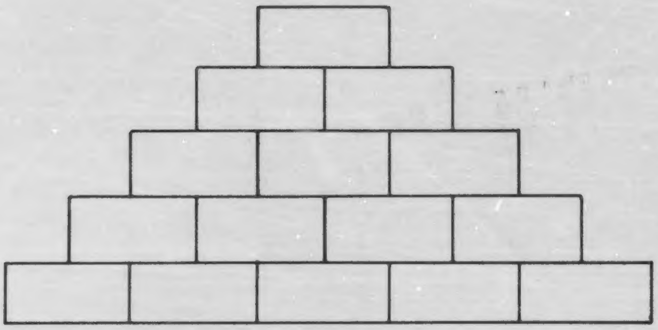
TM #4

PBL - 23-C

# Types of Leads (Block)



Outside Corner



Rack Back

# WALL LAYOUT
## UNIT I

## JOB SHEET #1 — LAY OUT AND CONSTRUCT A SECTION OF WALL CONTAINING JOINT REINFORCEMENT

I. Equipment and materials

A. Steel tape, 50- or 100-foot

B. Bricklayer's modular rule

C. Trowel

D. Framing square

E. Story pole

F. Brick hammer

G. Concave jointer

H. Level, 4-foot

I. Chalk line

J. Mason's line

K. Heavy-duty marking pencil

L. Keel (marking crayon)

M. Line pins and line blocks

N. Bolt cutter

O. Dusting brush

P. Masonry saw with dry blade

Q. 150 face bricks

R. 23 square-end concrete half blocks, 8" x 8" x 16"

S. 4 square-end concrete half blocks, 8" x 8" x 8"

T. Joint reinforcement for 12-inch wall

U. Laboratory mortar

V. 5-gallon water pail and water

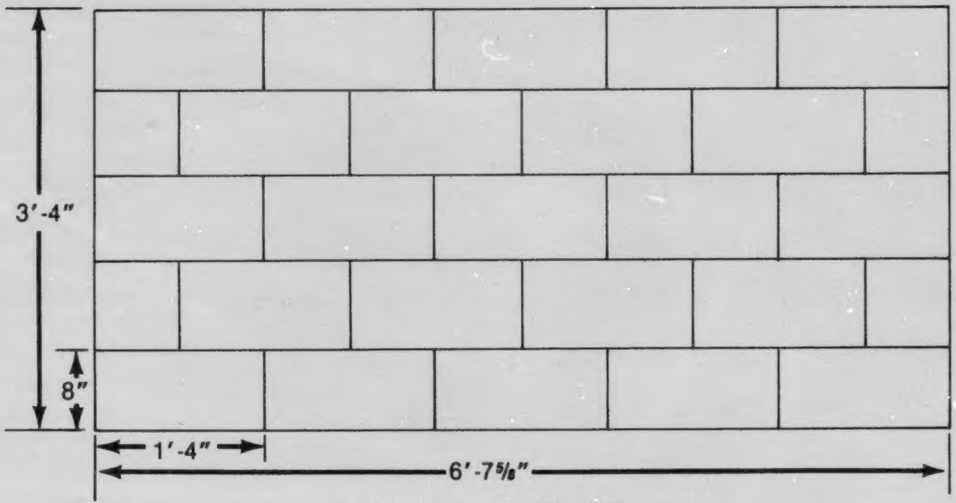
W. Specifications furnished by instructor

## JOB SHEET #1

II. Procedure

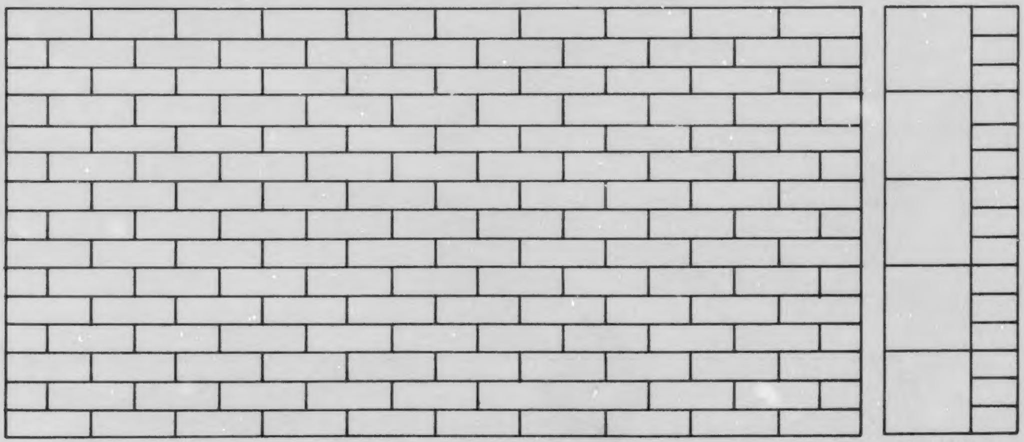
(NOTE: Construct the wall section, using the plan below [Figures 25 and 26] and the procedure outlined on the following pages.)

FIGURE 25



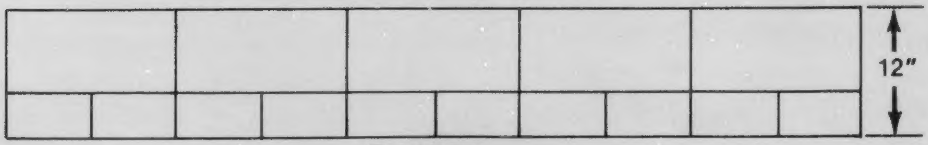
Elevation Showing Block Bond

FIGURE 26



Elevation Showing Brick Bond

End View



Top View

## JOB SHEET #1

A. Establish wall line

(NOTE: Some specifications call for the brick wall to be built first.)

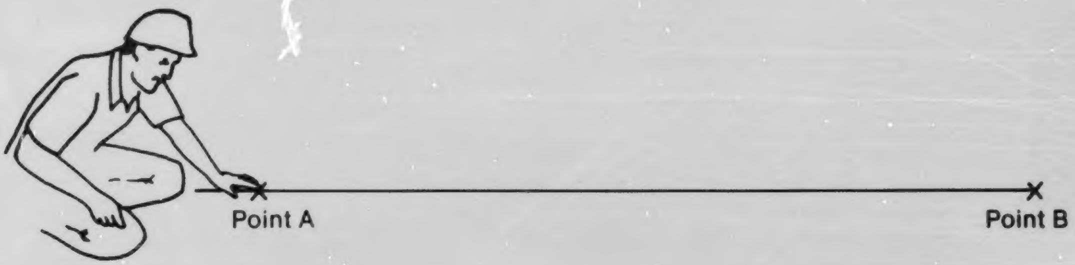
1. Locate known reference points

   (NOTE: Instructor in a laboratory situation should designate points for reference or starting points.)

2. Snap a chalk line from point A to point B (Figure 27)

   (NOTE: This step establishes the exterior wall line.)

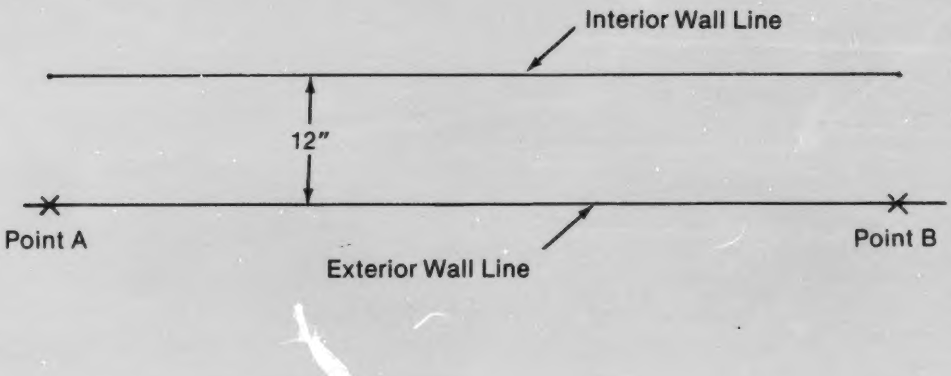
FIGURE 27


Point A
Point B

3. Establish interior wall line by measuring a distance of 12 inches from points A and B on exterior wall line (Figure 28)

   (NOTE: The interior wall line should parallel the exterior wall line.)

FIGURE 28


Interior Wall Line
12"
Point A
Point B
Exterior Wall Line

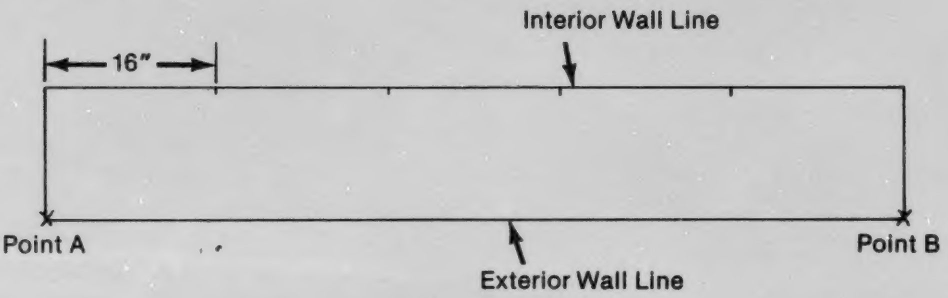
## JOB SHEET #1

4. Establish both ends of wall by squaring end lines between interior and exterior wall lines at points A and B (See Figure 29)

5. With steel tape, measure and mark every 16 inches on interior wall line (Figure 29)

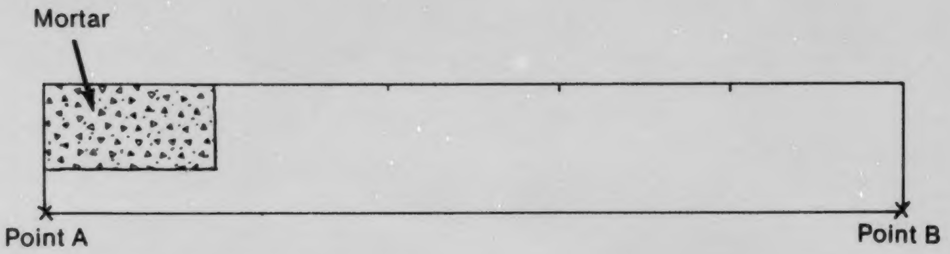
   (NOTE: These marks indicate the block bond.)

FIGURE 29



6. Spread bed mortar for first block at point A end of wall (Figure 30)

FIGURE 30



7. Pick up block and gently position it, keeping block straight with interior wall line and end line

8. Spread mortar and set second block at point B end of wall

9. Check course height with story pole

B. Lay first course of block to the mason's line

   (NOTE: The first course of the wall is very critical. The blocks should be in proper alignment with wall line, plumb, level, and square.)

## JOB SHEET #1

C. Lay second course of block to mason's line

D. Check course height with story pole

E. Remove mason's line

F. Parge exterior face of concrete blocks

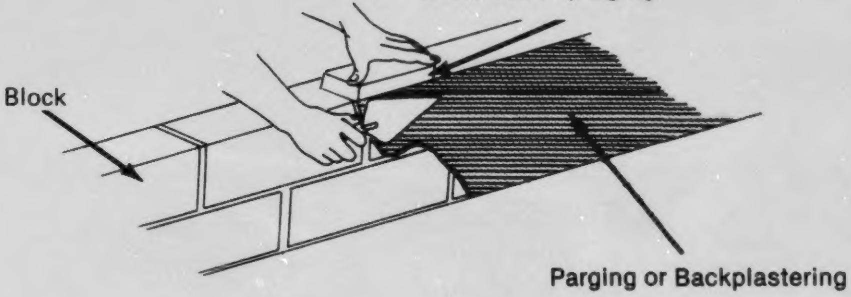
(NOTE: The exterior face is the face next to the brick.)

1. Starting at the bottom, apply a coat of mortar to face of block

2. Pick up mortar, apply to wall, and then spread with back of trowel

   (NOTE: Hold brick on top of block, using brick as a guide to get specified thickness of mortar. See Figure 31.)

FIGURE 31



Place brick on top of last course of face wythe for gauge to get specified thickness of parging.

3. Remove any mortar dropped on floor during parging

G. Lay out a dry bond for first course of brick

H. Mark floor at end of each brick

I. Remove dry bond

J. Lay first course of brick

(NOTE: Check height of each course with story pole.)

K. Build leads for five more courses of brick

## JOB SHEET #1

L. Lay the five courses of brick to the mason's line

(NOTE: Make sure that the height of the sixth course of brick is the same as the second course of block.)

M. Strike vertical and horizontal (head and bed) joints

N. Brush wall after striking to remove mortar burrs

O. Restrike joints to first-class finish

P. Place joint reinforcement

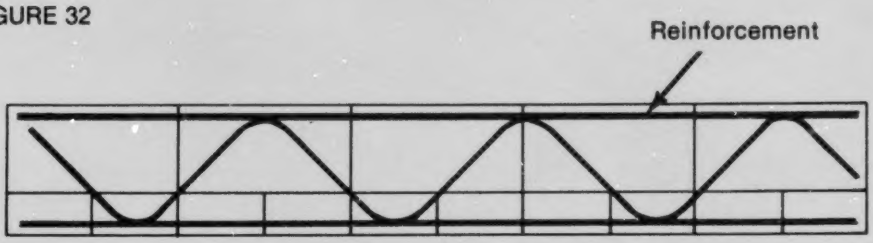
(NOTE: Joint reinforcement will be placed every 16 inches.)

Q. Use bolt cutters to cut reinforcement 2 inches shorter than wall length

R. Place reinforcement on wall, keeping it centered on wall and 1 inch from each end (Figure 32)

(NOTE: Centered reinforcement ensures a better mortar bed joint.)

FIGURE 32



Top View

S. Place mortar for leads

(NOTE: Be sure that reinforcement is thoroughly covered with mortar.)

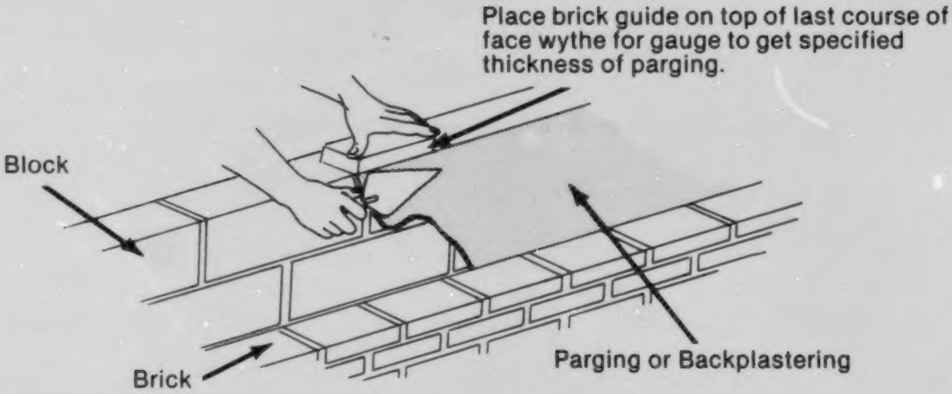
T. Build a two-course lead on one end; then build a two-course lead on other end

U. Lay block to line for two courses

## JOB SHEET #1

V. Parge face of the two courses of block (Figure 33)

FIGURE 33



Place brick guide on top of last course of face wythe for gauge to get specified thickness of parging.

W. Build six-course leads of brick at points A and B

X. Lay six courses of brick to mason's line

Y. Strike if necessary

Z. Cut and place reinforcement on mortar, pressing into mortar for proper bond

AA. Place mortar for last course of block

BB. Lay last course of block

CC. Parge face of block

DD. Lay last three courses of brick

EE. Strike all head and bed joints

FF. Brush wall after striking to remove mortar burrs

GG. Restrike joints to first-class finish

HH. Have instructor evaluate wall section

II. Clean work area; clean and put away all tools and equipment

# WALL LAYOUT
## UNIT I

## JOB SHEET #2 — LAY OUT AND CONSTRUCT A SECTION OF WALL CONTAINING OPENINGS AND JOINT REINFORCEMENT

I. Equipment and materials

- A. Steel tape, 50- to 100-foot
- B. Bricklayer's modular rule
- C. Trowel
- D. Framing square
- E. Story pole
- F. Brick hammer
- G. Concave jointer
- H. Level, 4-foot
- I. Dusting brush
- J. Chalk line
- K. Mason's line
- L. Heavy-duty marking pencil
- M. Line pins
- N. Line blocks
- O. Bolt cutters
- P. 5-gallon water pail and water
- Q. 150 face brick
- R. 20 square-end concrete blocks, 8" × 8" × 16"
- S. 10 square-end concrete half blocks, 8" × 8" × 8"
- T. Joint reinforcement for 12-inch wall
- U. Laboratory mortar
- V. Specifications furnished by instructor
- W. 3 steel lintels, 3' - 4" × 3 1/2" × 3 1/2" × 3/8"
- X. 3 steel lintels, 2' - 0" × 3 1/2" × 3 1/2"

## JOB SHEET #2

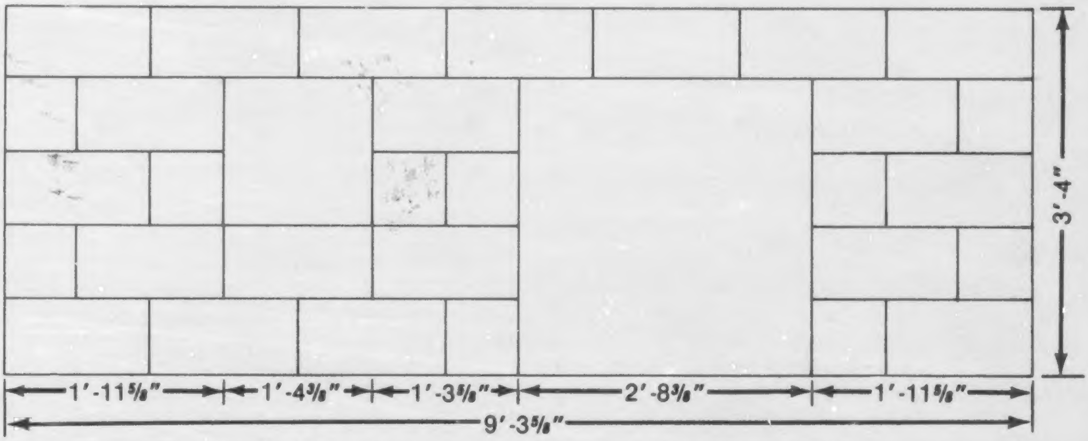
Y. Goggles

Z. Dust respirator

II. Procedure

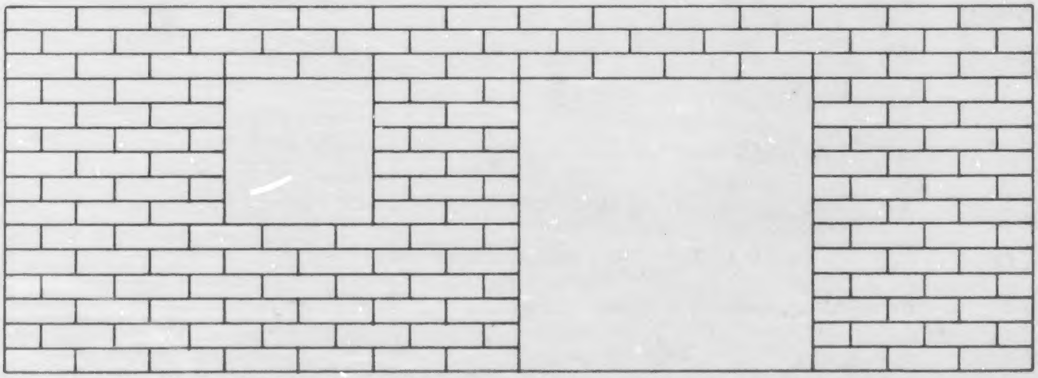
(NOTE: Construct the wall section, using the plan below [Figures 34 and 35] and the procedure outlined on the following pages.)

FIGURE 34



Elevation Showing Block Bond with Door and Window Openings

FIGURE 35



Elevation Showing Brick Bond with Door and Window Openings

## JOB SHEET #2

A. Establish wall lines

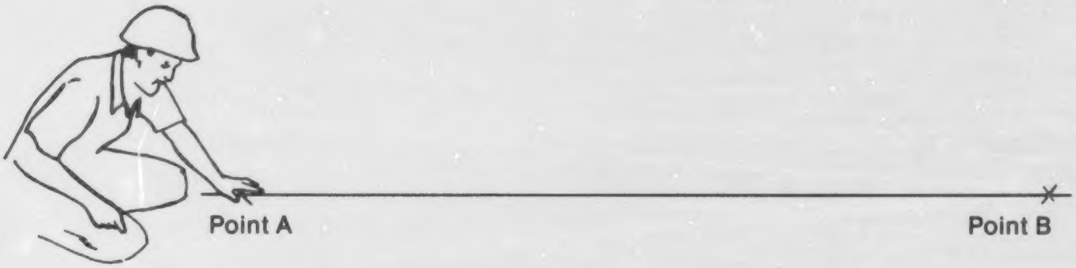
1. Locate known reference points

   (NOTE: Instructor in a laboratory setting should designate point of reference or starting point.)

2. Snap a chalk line from point A to point B (Figure 36)

   (NOTE: This step establishes the exterior wall line.)

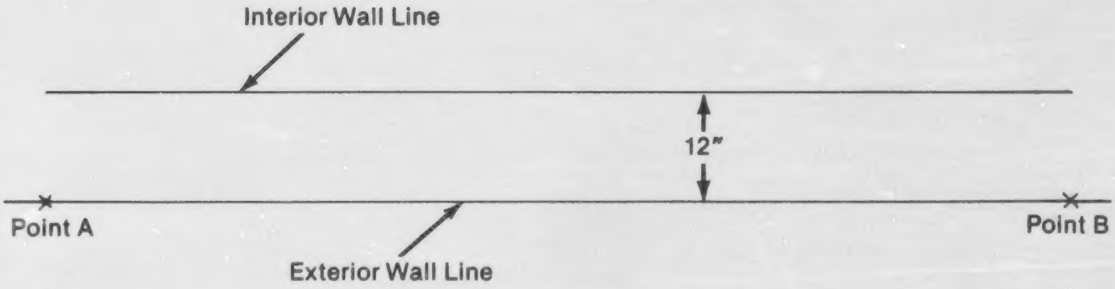
FIGURE 36


Point A
Point B

3. Establish interior wall line by measuring a distance of 12 inches from points A and B on exterior wall line (Figure 37)

   (NOTE: This line should be parallel to the exterior wall line.)

FIGURE 37


Interior Wall Line
12"
Point A
Point B
Exterior Wall Line

4. Square end lines between interior and exterior wall lines at points A and B

5. Check wall lines for dimension accuracy

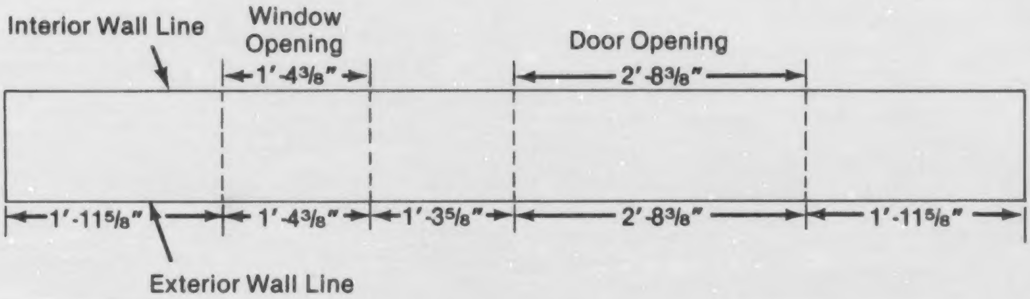
## JOB SHEET #2

B. Lay out block bond

1. Measure with steel tape and mark door opening as shown on plan (Figure 38)

   (NOTE: When marking door opening, use a piece of keel or marking crayon.)

FIGURE 38


Interior Wall Line
Window Opening
1'-4³/₈"
Door Opening
2'-8³/₈"
1'-11⁵/₈"
1'-4³/₈"
1'-3⁵/₈"
2'-8³/₈"
1'-11⁵/₈"
Exterior Wall Line

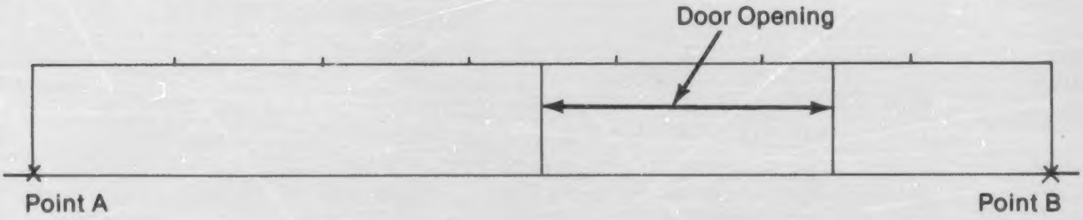
2. Square door opening from exterior to interior wall lines

   (NOTE: Mark door jamb with marking crayon.)

3. Measure with steel tape and mark block bond every 16 inches (Figure 39)

   (NOTE: Mark block bond through door opening to end of wall. This will assure a good bond when blocks are laid across top of door opening.)

FIGURE 39


Door Opening
Point A
Point B

## JOB SHEET #2

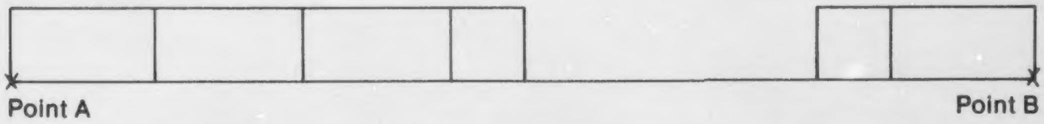
C. Lay first course of blocks to mason's line

(NOTE: Check each course height with story pole. It is very critical that the blocks in the first course are plumb, level, square, and in proper alignment with wall lines.)

D. Check door opening for accurate dimensions (Figure 40)

(NOTE: Instructors may have students build a rough door frame to keep door opening accurate.)

FIGURE 40

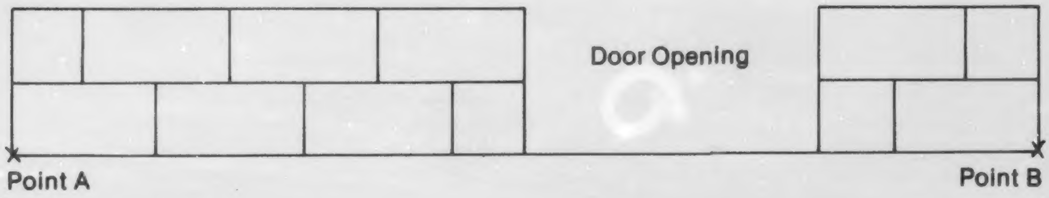


E. Remove mason's line

F. Lay corner blocks of second course

G. Lay remainder of second course of blocks to the line (Figure 41)

FIGURE 41



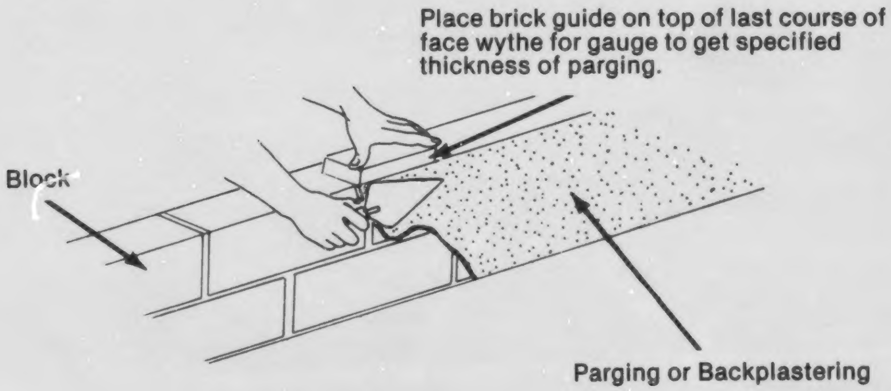
## JOB SHEET #2

H. Parge exterior face of concrete blocks

1. Starting at bottom, apply a coat of mortar to face of block (Figure 42)

2. Pick up mortar, apply to wall, and then spread with back of trowel

FIGURE 42


Place brick guide on top of last course of face wythe for gauge to get specified thickness of parging.
Block
Parging or Backplastering

3. Remove any mortar dropped on floor during parging

I. Lay out dry bond for first course of brick

J. Mark floor at ends of each brick

K. Remove dry bond

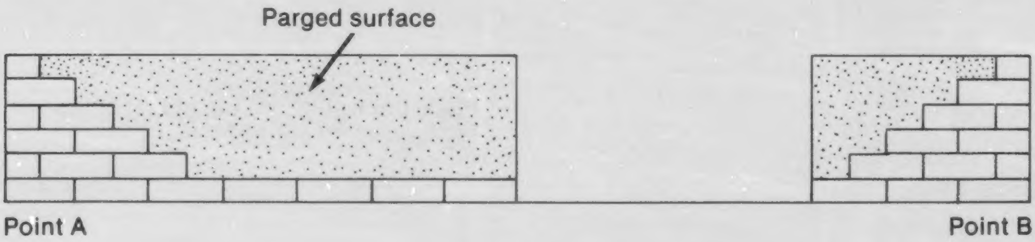
L. Lay first course of brick to mason's line

M. Check door opening for accurate dimensions

## JOB SHEET #2

N. Build a five-course lead at both point A and point B (Figure 43)

FIGURE 43



O. Lay five courses of brick to mason's line

(NOTE: Constantly check door opening height. Also check to see if sixth course of brick is same as second course height of block.)

P. Strike head and bed joints if necessary

Q. Select joint reinforcement for a 12-inch brick-faced wall with 8-inch block on interior

(NOTE: Keep joint reinforcement centered on wall.)

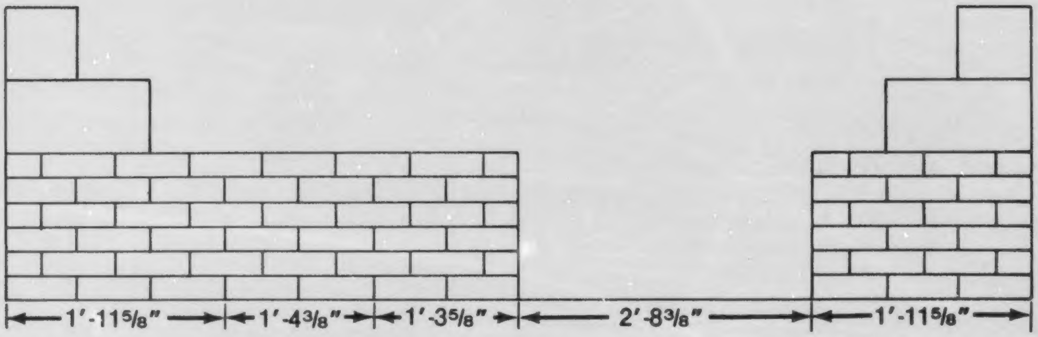
1. Use bolt cutters to cut reinforcement 2 inches shorter than section of wall from point A to door jamb
2. Cut reinforcement 2 inches shorter than section of wall from point B to door jamb
3. Place reinforcement every 16 inches vertically

## JOB SHEET #2

R. Lay two-course block lead at both point A and point B

1. Use steel tape to mark out window opening shown on shop plan
2. Square window opening from marks that were taped to interior wall line (Figure 44)

FIGURE 44



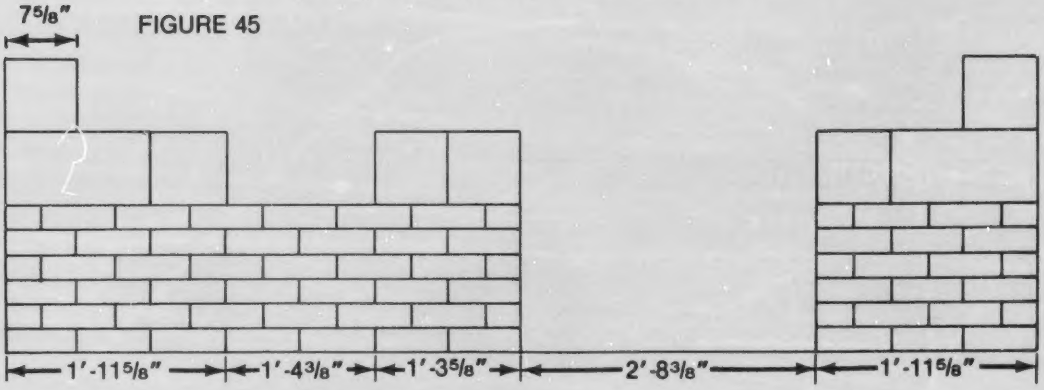
S. Use masonry saw to dry cut half block to measure 7 ⁵/₈ inches at its length

(NOTE: This should be done before placing mortar for half blocks. The half block is cut because the full block on next course measures 15 ⁵/₈ inches.)

T. Lay two courses of block to the line

U. Check window opening for accurate dimensions (Figure 45)

FIGURE 45

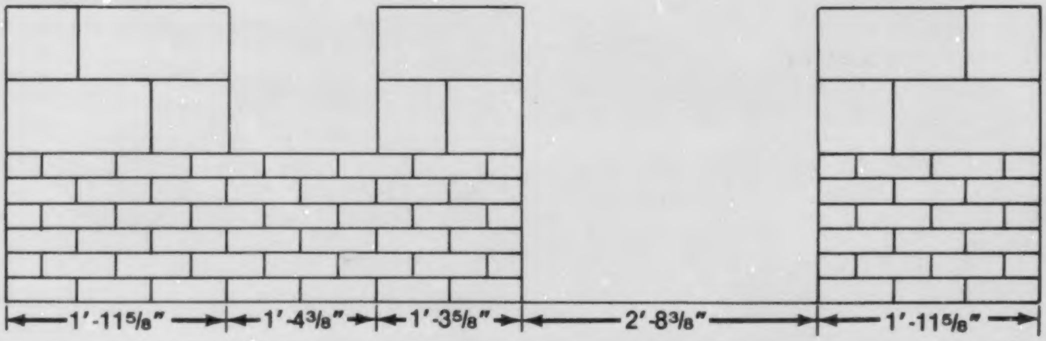


Elevation Showing Brick Bond with Door and Window Openings

## JOB SHEET #2

V. Plumb window and door openings, making sure that they are perfectly plumb and level at tops of openings (Figure 46)

FIGURE 46



W. Check stiffness of mortar joints and strike, if necessary, using concave jointer

X. Brush wall to remove mortar burrs

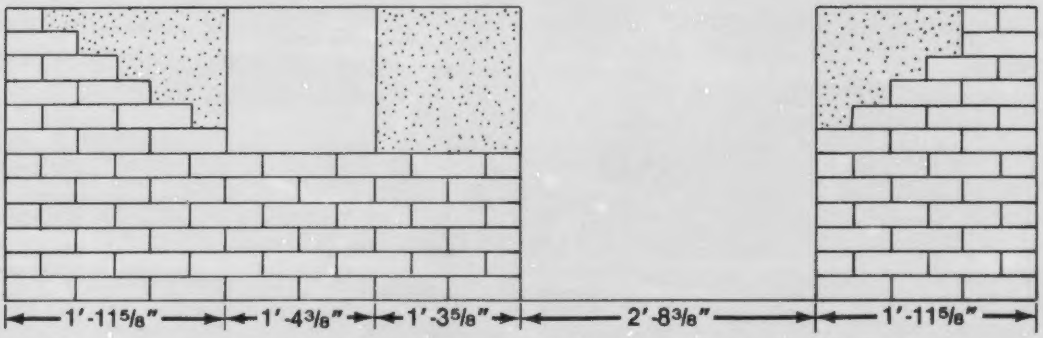
Y. Temper mortar if necessary to a good, workable mortar

Z. Parge exterior face of concrete block

AA. Scrape off mortar that may have dropped on brick course during parging of block wall

BB. Lay six-course brick lead at both point A and point B (Figure 47)

FIGURE 47

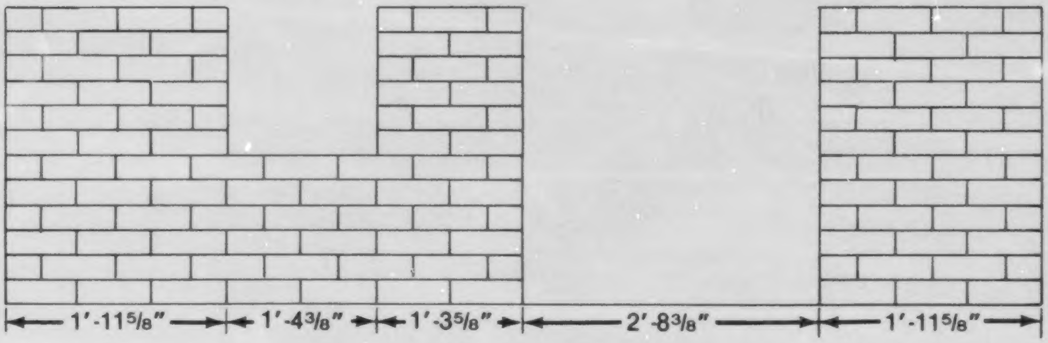


Elevation Showing Brick Bond with Door and Window Openings

## JOB SHEET #2

CC. Lay six courses of brick to mason's line (Figure 48)

FIGURE 48



Elevation Showing Brick Bond with Door and Window Openings

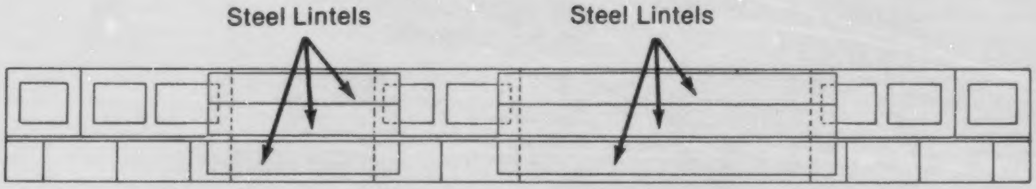
DD. Check window and door jambs to see if plumb

EE. Check mortar in joints; strike if necessary

FF. Place all lintels over tops of openings, keeping back of lintel tight against parging so that you will have enough room to lay brick across angle without cutting backs of brick

(NOTE: Make sure that you have equal bearing on jambs. See Figure 49.)

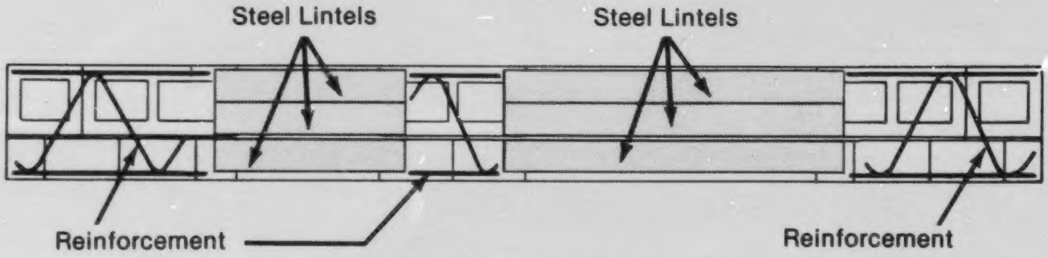
FIGURE 49



JOB SHEET #2

GG. Use bolt cutters to cut joint reinforcement to fit between lintels and from lintels to ends of wall; center reinforcement, keeping it 1 inch from end of wall (Figure 50)

FIGURE 50



HH. Before laying fifth or last course of block, cut the five blocks to be laid on lintels

1. Place top of block or thick side of block down on table of masonry saw, lining it up square with blade and 2 inches outside of blade
2. Cut each web of block to a depth of 4 inches
3. Move block over and repeat procedure, keeping block on table and cutting webs the full length of block

   **(CAUTION: Hold the block firmly with both hands and keep fingers away from blade. Wear goggles and dust respirator.)**

4. Tap cut webs gently with brick hammer so as not to fracture block
5. Cut four more blocks, using same procedure, but leaving last web on block

   (NOTE: Only one block has to be cut the full length of block.)

II. Lay fifth course of block

JJ. Page exterior face of blocks, and clean brick course of any mortar that may have dropped during parging

KK. Build three-course brick leads at points A and B

## JOB SHEET #2

LL. Lay three courses of brick to mason's line

(NOTE: When laying the first course of brick on lintel or top of opening, do not place mortar on lintel. If wall is to be continued, place joint reinforcement every two courses of blocks for the remainder of the height of the wall.)

MM. Strike all joints

NN. Brush wall to remove all mortar burrs

OO. Restrike joints to first-class finish

PP. Have instructor evaluate wall

QQ. Clean work area; clean and put away all tools and equipment

# WALL LAYOUT
## UNIT I

## TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with wall layout to their correct definitions. Write the correct numbers in the blanks. Definitions are continued on the next page.

______a. Plastering of masonry walls with mortar

______b. Wall that supports only its own weight

______c. Masonry in which the cavity is filled with grout

______d. Length of wood marked for course levels and/or heights and openings

______e. Pattern in which bricks are laid

______f. Construction crayon

______g. Section of wall built up and racked back on successive courses

______h. Wall that not only supports itself but the structure above

______i. Continuous section of masonry one unit in thickness

______j. Method of determining brick bond by laying brick without mortar

______k. Horizontal member placed over wall openings to support the weight of masonry above

______l. Thin mixture of mortar; poured into wall cavity for bonding purposes

______m. Temporary structure or platform to support workers and material during construction

______n. Method of bonding by joining outer and inner walls

1. Load-bearing wall
2. Brick bond
3. Scaffold
4. Lead
5. Dry bond
6. Rack
7. Parging
8. Through-wall bonding
9. Grout
10. Story pole
11. Scaffold-high
12. Non-load-bearing wall
13. Wythe
14. Reinforced masonry
15. Keel
16. Lintel
17. Grouted masonry
18. Strike
19. Cavity

TEST

_____o. Unit of masonry in which reinforcement is embedded to give additional strength to wall

_____p. Air space or opening between two wythes of masonry units

_____q. High enough to use a scaffold to continue construction

_____r. To tool joints

_____s. To set back the end of each course from the end of preceding course

2. State two purposes of wall layout.

a. ________________________________________

b. ________________________________________

3. Arrange in order the procedures for laying out a wall. Write a "1" in the blank before the first procedure, a "2" before the second procedure, and so on.

_____a. Measure from point A (starting point) to end of wall; square a mark at this point

_____b. Establish opposite side of wall by marking points on a line parallel to chalk line by a distance of proposed wall thickness

_____c. Snap a chalk line between these two new points

_____d. Locate reference points (A and B) for wall line

_____e. Snap a chalk line from point A to point B

_____f. Use framing square to square from point A across to second line

4. Discuss the purposes of laying out brick bonds.

________________________________________

________________________________________

________________________________________

________________________________________

## TEST

5. Name methods of layout.

a. ______________________________

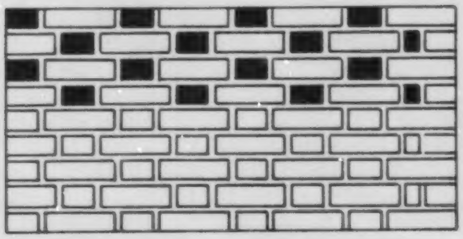
b. ______________________________

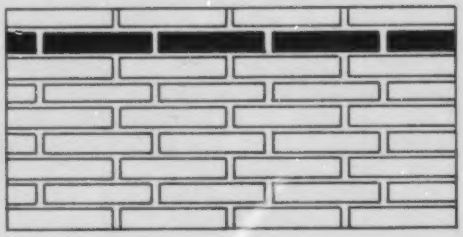
6. Discuss purposes of bonds.

______________________________

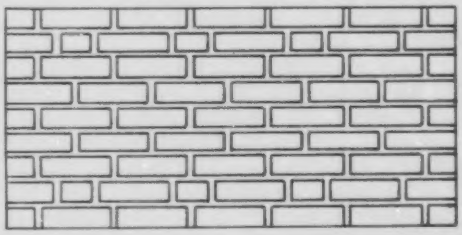
______________________________

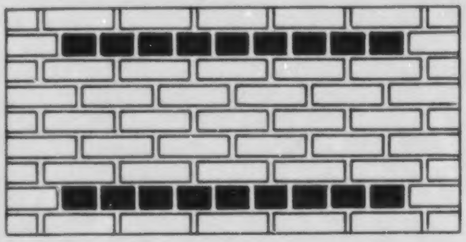
7. Label types of wall bonds. Write the correct names in the blanks.





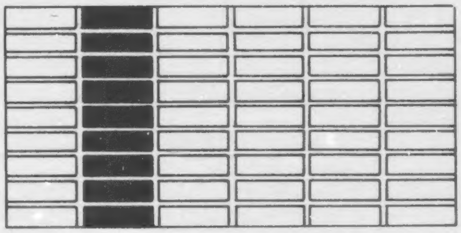
a. ______________________ b. ______________________



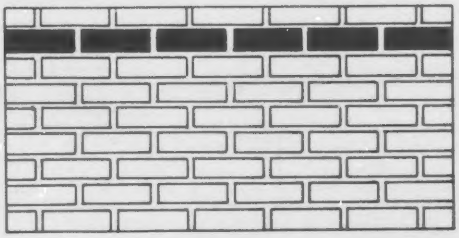


c. ______________________ d. ______________________

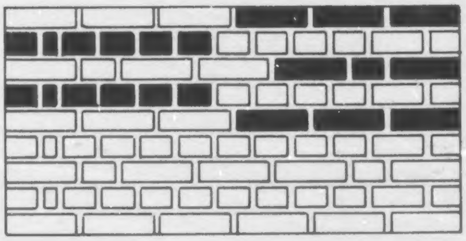
## TEST



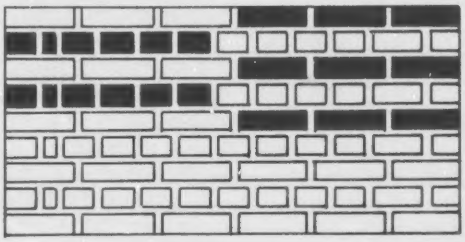
e. ______________________



f. ______________________



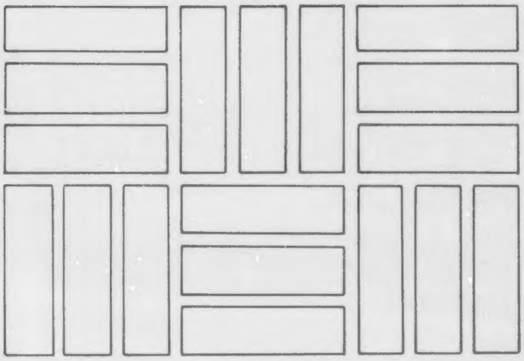
g. ______________________



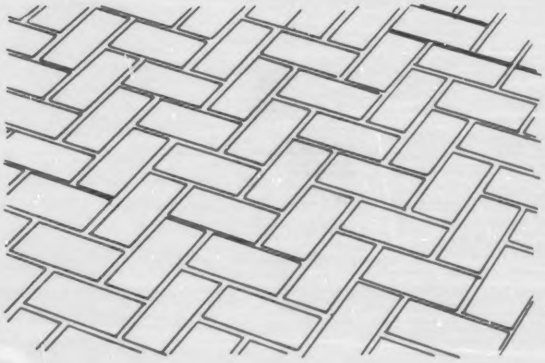
h. ______________________

## TEST

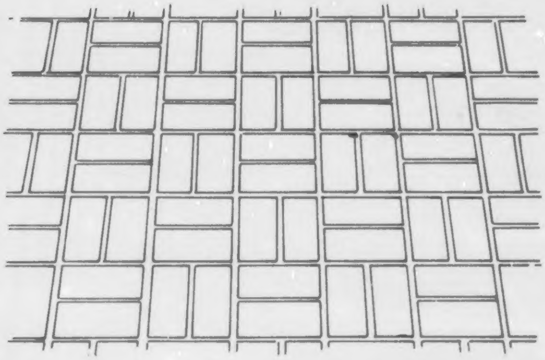
8. Label types of paving or panel bonds. Write the correct names in the blanks.



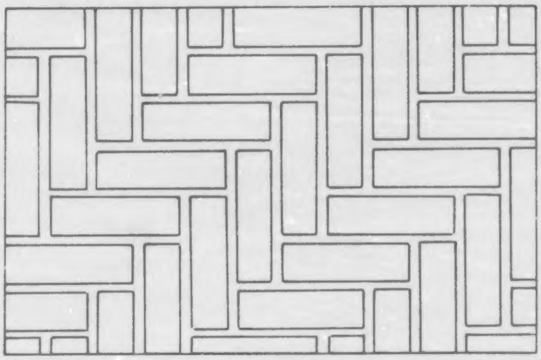
a. ______________________________



b. ______________________________



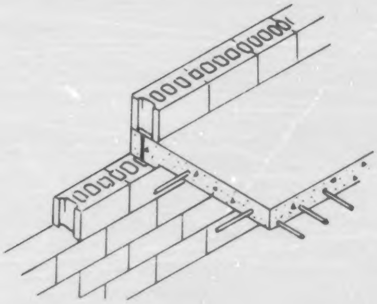
c. ______________________________



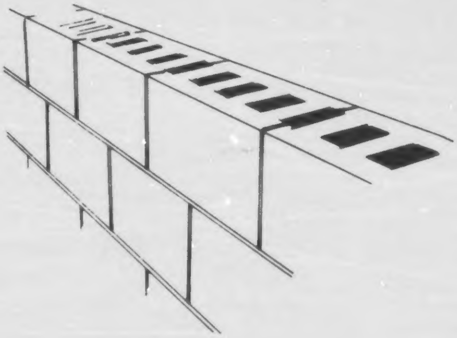
d. ______________________________

## TEST

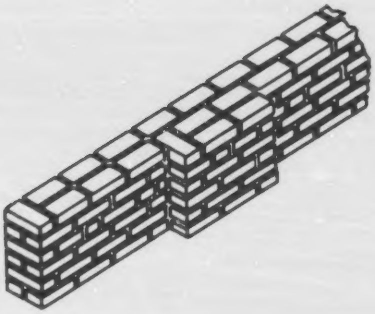
9. Distinguish between load-bearing and non-load-bearing walls. Write an "X" in the blanks under load-bearing walls.



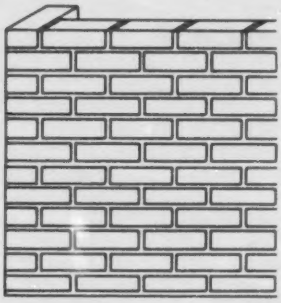
a. ______________________



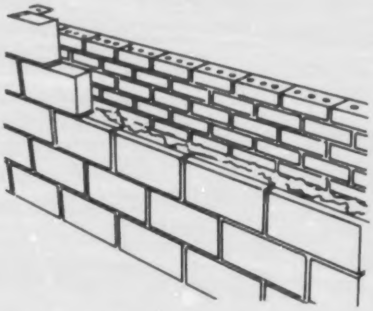
b. ______________________



c. ______________________



d. ______________________



e. ______________________

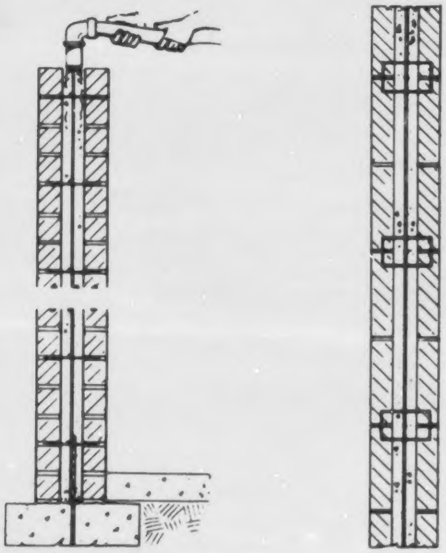
## TEST

10. State purpose of through-wall bonding.______________________________

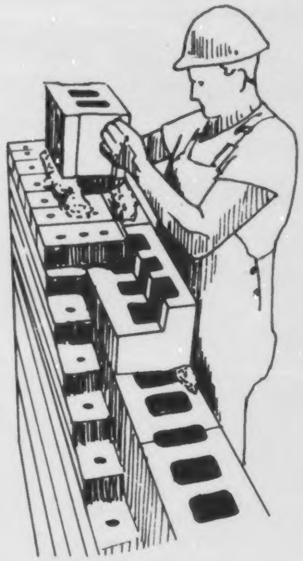
______________________________________________________________

______________________________________________________________

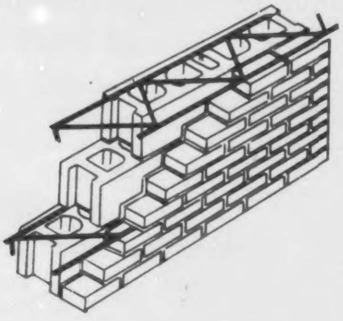
11. Label types of through-wall bonding. Write the correct names in the blanks.



a. ______________________________



b. ______________________________



c. ______________________________

## TEST

12. State the purposes of grouting.

    a. ______________________________

    b. ______________________________

13. List types of reinforcement.

    a. Grout/steel

        1) ______________________________

        2) ______________________________

    b. Reinforcing steel

        1) ______________________________

        2) ______________________________

        3) ______________________________

        4) ______________________________

14. State two purposes of leads.

    a. ______________________________

    b. ______________________________

15. Name three types of leads.

    a. ______________________________

    b. ______________________________

    c. ______________________________

(NOTE: Test question 16 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

16. Demonstrate the ability to

    a. Lay out and construct a section of wall containing joint reinforcement.

    b. Lay out and construct a section of wall containing openings and joint reinforcement.

# WALL LAYOUT
# UNIT I

## ANSWERS TO TEST

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. | a. | 7 | f. | 15 | k. | 16 | p. | 19 |
| | b. | 12 | g. | 4 | l. | 9 | q. | 11 |
| | c. | 17 | h. | 1 | m. | 3 | r. | 18 |
| | d. | 10 | i. | 13 | n. | 8 | s. | 6 |
| | e. | 2 | j. | 5 | o. | 14 | | |

2. Answer should include any two of the following
   - a. Establishing wall locations
   - b. Establishing bonds
   - c. Establishing openings
   - d. Establishing elevations

| | | | | | | |
|---|---|---|---|---|---|---|
| 3. | a. | 6 | c. | 4 | e. | 2 |
| | b. | 3 | d. | 1 | f. | 5 |

4. Discussion should include the following
   - a. Establishing in place and marking position of each brick of first course to ensure a true bond
   - b. Locating all openings so that bond can be regulated or fitted to dimensions called for on plans

5. Answer should include the following
   - a. Dry bonding
   - b. Steel tape bonding

## ANSWERS TO TEST

6. Discussion should include the following

    a. Adding strength and rigidity to the wall

    b. Beautifying through design and economy of design

7. a. Flemish

    b. One-third running

    c. Common or Flemish header

    d. Common or full header

    e. Stack

    f. Running

    g. English cross or Dutch

    h. English

8. a. Basket weave on edge

    b. Herringbone flat

    c. Basket weave flat

    d. Herringbone regular

9. a, c, e

10. Answer should include the following

    Joining outer and inner wythes to strengthen wall

11. a. Grouting and reinforcement

    b. Header construction

    c. Joint reinforcement or heavy-gauge ties

12. Answer should include the following

    a. Providing greater strength in masonry

    b. Forming a single unit of construction to resist forces

13. a. Grout/steel

    1) Low-lift grout used with reinforcing steel

    2) High-lift grout used with reinforcing steel

## ANSWERS TO TEST

b. Reinforcing steel

   1) Reinforcing bars

   2) Metal lath

   3) Wire screen

   4) Reinforcing wire

14. Answer should include any two of the following

    a. Maintaining proper elevation

    b. Establishing wall pattern

    c. Acting as a guide for wall construction

15. Answer should include any three of the following

    a. Outside corner

    b. Angle or inside corner

    c. Rack back

    d. Corner pole

16. Performance skills evaluated to the satisfaction of the instructor

# SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## UNIT OBJECTIVE

After completing this unit, the student should be able to lay block and brick and use a brick trowel to pick up mortar, place mortar, and spread mortar. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with spreading mortar and laying block and brick.
2. Describe the correct way to hold a brick trowel.
3. Label methods of picking up mortar from mortarboard.
4. Arrange in order procedures used to pick up mortar.
5. Describe why wrist is snapped when picking up mortar.
6. Explain direction of travel for placing mortar.
7. Arrange in order procedures for placing mortar.
8. Identify direction of travel for laying brick or block.
9. Label types of bedding.
10. State purposes of the frog.
11. Select from a list basic skills used in masonry work.
12. Label methods used to align masonry units.
13. State bricklaying safety rules.
14. Demonstrate ability to
    a. Spread mortar on a two-by-four.
    b. Swipe mortar on a two-by-four for block.
    c. Lay block to established leads.

## OBJECTIVE SHEET

d. Build a 90-degree block lead.

e. Spread mortar on a two-by-four for brick.

f. Lay brick to established leads.

g. Build a 90-degree brick lead.

# SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## SUGGESTED ACTIVITIES

I. Suggested activities

   A. Gather equipment and materials for job sheet demonstrations.

   B. Obtain transparencies.

   (NOTE: Transparencies are available from AGC and CIMC.)

   C. Provide students with objective sheet.

   D. Discuss unit and specific objectives.

   E. Provide students with information and job sheets.

   F. Discuss information sheet.

   G. Demonstrate and discuss procedures outlined in job sheets.

   H. If there are no advanced students, build leads for job sheets #3 and #6.

   I. Provide equipment and materials for students so that they may complete procedures outlined in the job sheets.

   J. Give test.

   K. Complete appropriate section of competency profiles.

   (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM #1 — Correct Way to Hold a Brick Trowel

      2. TM #2 — Methods of Picking Up Mortar

      3. TM #3 — Direction of Travel When Laying Brick

      4. TM #4 — Types of Bedding

## SUGGESTED ACTIVITIES

E. Job sheets

1. Job Sheet #1 — Spread Mortar on a Two-by-Four
2. Job Sheet #2 — Swipe Mortar on a Two-by-Four for Block
3. Job Sheet #3 — Lay Block to Established Leads
4. Job Sheet #4 — Build a 90-Degree Block Lead
5. Job Sheet #5 — Spread Mortar on a Two-by-Four for Brick
6. Job Sheet #6 — Lay Brick to Established Leads
7. Job Sheet #7 — Lay a 90-Degree Brick Lead

F. Test

G. Answers to test

III. References

A. Graham, Frank D. *Audel's Masons and Builders Guide,* Vol. 1. Indianapolis, Indiana: Theodore Audel and Co./Howard W. Sams and Co., Inc., 1961.

B. Kreh, R.T., Sr. *Masonry Skills.* Albany, New York: Delmar Publishers, 1982.

C. *Masonry.* Memorandum 535. Fort Belvoir, Virginia: U.S. Army Engineer School, n.d.

D. Roark, William F., and Harry C. Plummer. *Bricklaying Vocational Training.* McLean, Virginia: Brick Institute of America, 1973.

E. Taylor, Merlin, and Harland Randolph. *The Bricklayer,* Vol. 2, *Brick and Block Construction.* Washington, D.C.: International Masonry Apprenticeship Trust, 1977.

F. Turcotte, Raymond J. *Bricklaying Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1977.

## SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## INFORMATION SHEET

I. Terms and definitions

A. Bed joint — Horizontal mortar joint between two units

B. Block or brick leads — Sections of wall built up and racked back on successive courses; used to attach line as guide for constructing wall between them

C. Closure — Last unit laid in a course

D. Consistency — Relative mobility, or ability of fresh mortar to flow

E. Deadman — Something to which the line is attached for lead or first course

(NOTE: A deadman could be a pole, brace, or even another block.)

F. Ferrule — Metal cap around handle of brick trowel at shank end

G. Frog — Depression, such as a groove or recess, in one or both of the larger sides of a brick or block; provides key for mortar at joints

H. Furrow — Slight indentation made in bed joint mortar

I. Laboratory mortar — Mixture of lime, sand, and water

J. Level — To cause to conform to a specified grade; perfect horizontal plane

K. Line blocks — Plastic or wood blocks used to hold line tight

L. Mortar — Mixture of cementitious materials, such as portland cement, lime, sand, and water

M. Mortar body — Consistency or density of mortar that is plastic and workable

N. Head joint — Vertical mortar joint between two units

O. Plumb — Perfect vertical plane

P. Racking back — Method of stepping back successive courses

Q. Spreading mortar — Process of placing mortar for the course to be laid

R. Story pole — Wooden pole upon which are marked course heights and openings

S. Temper — To remix mortar to proper consistency

## INFORMATION SHEET

II. Correct way to hold a brick trowel (Figure 1; Transparency #1)

  A. Place fingers at bottom of handle

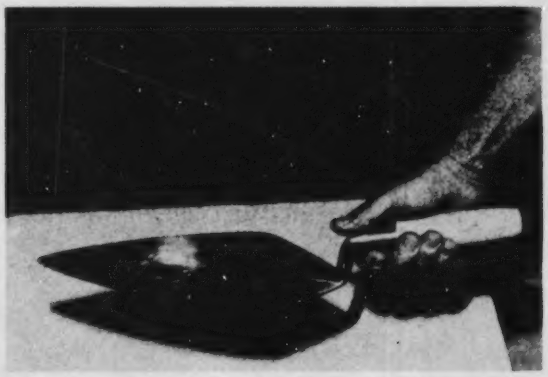
  B. Place thumb on top of ferrule, pointing toward point of blade

  C. Hold handle firmly, but with a relaxed grip

  D. Apply pressure between thumb and forefinger

  EXAMPLE:

FIGURE 1



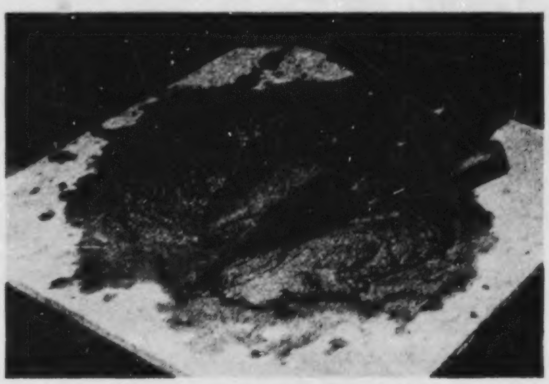
III. Methods of picking up mortar from mortarboard (Figures 2 and 3; Transparency #2)

  A. Cupping method (from the side of mortarboard)

  (NOTE: This method is the most widely used.)

  EXAMPLE:

FIGURE 2



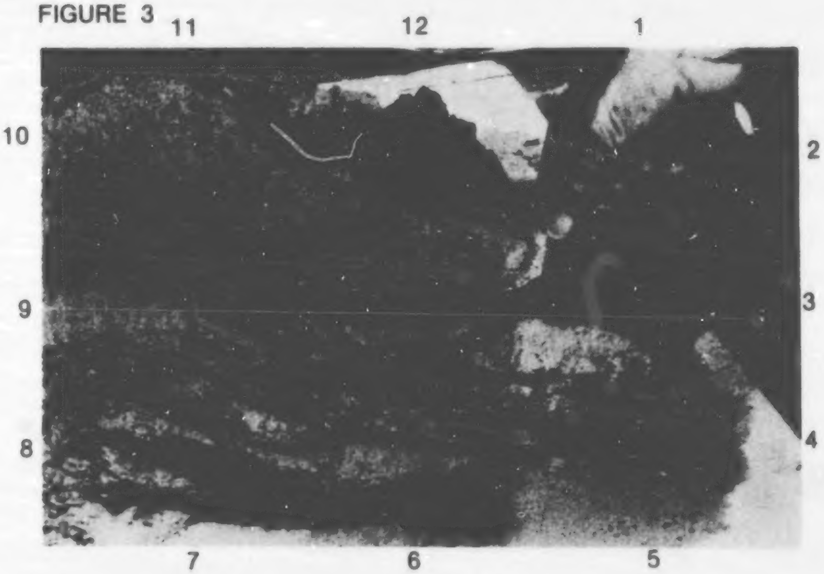
## INFORMATION SHEET

B. Clock method (from the middle of mortarboard)

(NOTE: There are several ways of using the trowel to cut mortar from the mortar pile, but the cupping and clock methods are the most common.)

EXAMPLE:

FIGURE 3



IV. Procedures used to pick up mortar (Figures 4-6)

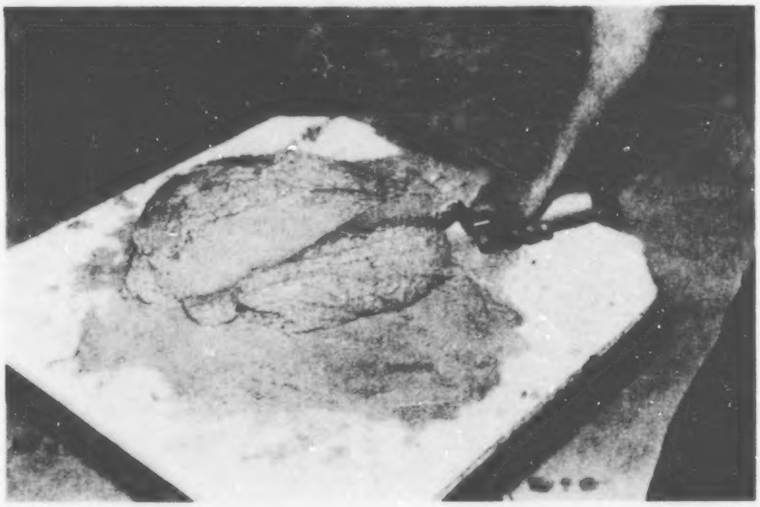
A. Use a downward slicing motion of trowel to separate a determined amount of mortar from main pile

## INFORMATION SHEET

B. Use a rolling motion to move the mortar to edge of mortarboard

EXAMPLE:

FIGURE 4

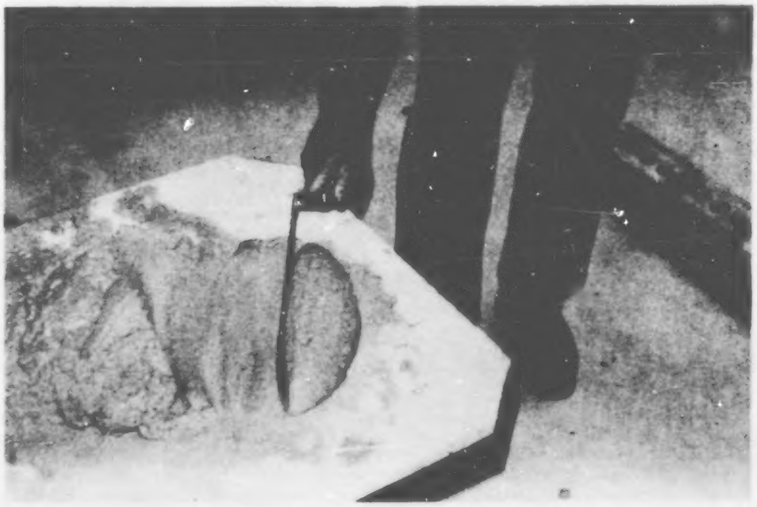


C. Use trowel to work mortar into a long, tapered shape

(NOTE: This is a convenient shape to pick up.)

EXAMPLE:

FIGURE 5

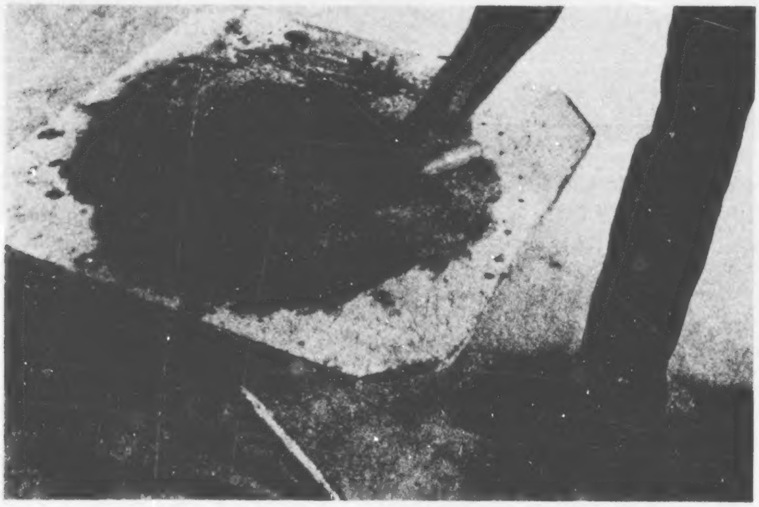


## INFORMATION SHEET

D. Hold trowel flat against mortarboard, and slide it forward under the small pile of mortar

EXAMPLE:

FIGURE 6



E. While pushing forward, lift mortar with an upward motion of trowel

(NOTE: With this motion, the trowel lifts the mortar free of the mortarboard.)

V. Why wrist is snapped when picking up mortar — To set mortar on the trowel to keep it from falling off

(NOTE: Snapping the wrist is one of the most important and difficult steps to master when picking up mortar for applying to block.)

VI. Direction of travel for placing mortar

A. Right-handed person

1. Spreads left to right
2. Moves backwards

B. Left-handed person

1. Spreads right to left
2. Moves backwards

## INFORMATION SHEET

VII. Procedures for placing mortar

- A. Load trowel
- B. Keep elbow slightly away from body

  (NOTE: When elbow is held slightly away from body, movement of the trowel hand is not restricted.)
- C. Use a sweeping motion to spread mortar
- D. Fill any spaces in bed joint with excess mortar

VIII. Direction of travel for laying brick or block (Transparency #3)

- A. Laying to hand

  (NOTE: Bricklayer walks forward.)
- B. Laying backhand or against hand

  (NOTE: Bricklayer walks backward.)
- C. Laying overhand

  (NOTE: This method is used when laying units on the outside working from the inside. The bricklayer also lays to or against hand when laying brick overhand.)

IX. Types of bedding (Transparency #4)

- A. Block
  - 1. Face shell
  - 2. Full mortar
- B. Brick
  - 1. Furrowed
  - 2. Tapered or beveled

X. Purposes of the frog

- A. Locks mortar into recess for better grip
- B. Creates special effects when bricks are laid on their sides
- C. Saves cost of material

  (NOTE: Some bricks have holes in the bottom, which also tend to provide a better bond. These are called *coved bricks.*)

## INFORMATION SHEET

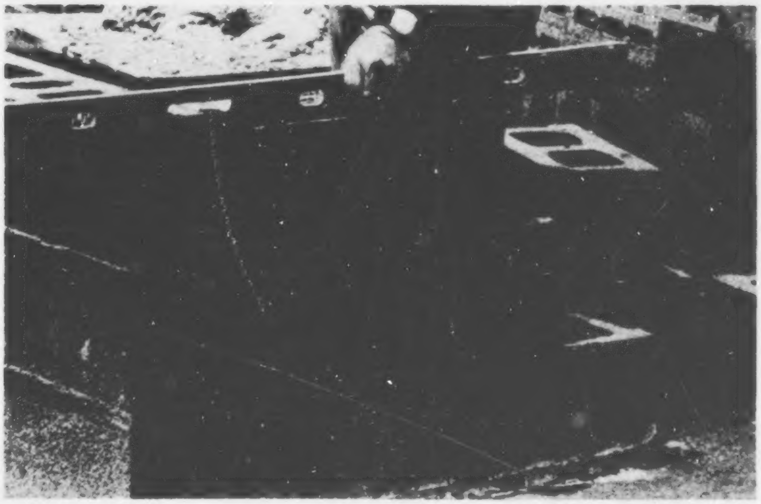
XI. Basic skills used in masonry work

- A. Spreading mortar with brick trowel
- B. Applying head joints to masonry
- C. Leveling masonry courses
- D. Plumbing masonry units
- E. Checking course height with a modular rule
- F. Checking alignment
- G. Striking mortar joints
- H. Brushing wall and striking joints
- I. Cutting masonry units with hammer and brick set
- J. Cutting masonry units with masonry saw

XII. Methods used to align masonry units (Figures 7-11)

- A. Leveling

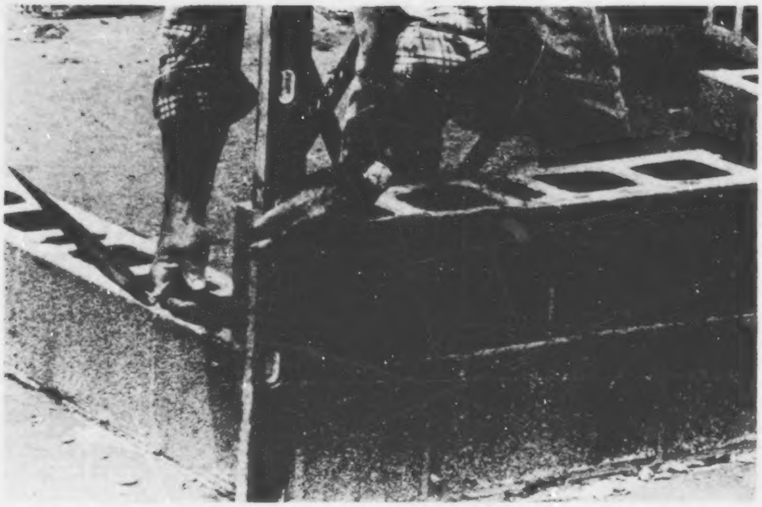
FIGURE 7



## INFORMATION SHEET

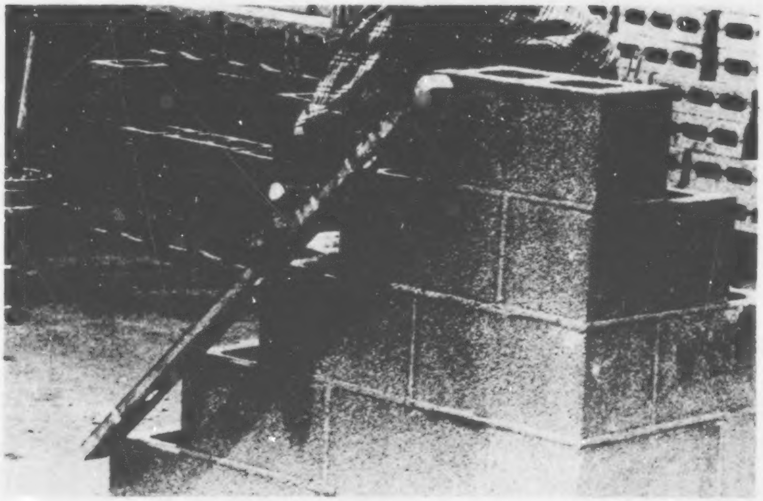
B. Plumbing

FIGURE 8



C. Racking or tailing a lead

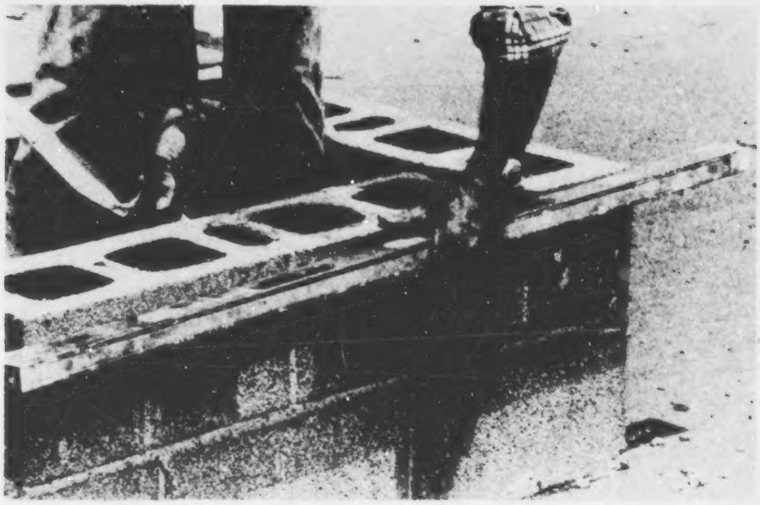
FIGURE 9



## INFORMATION SHEET

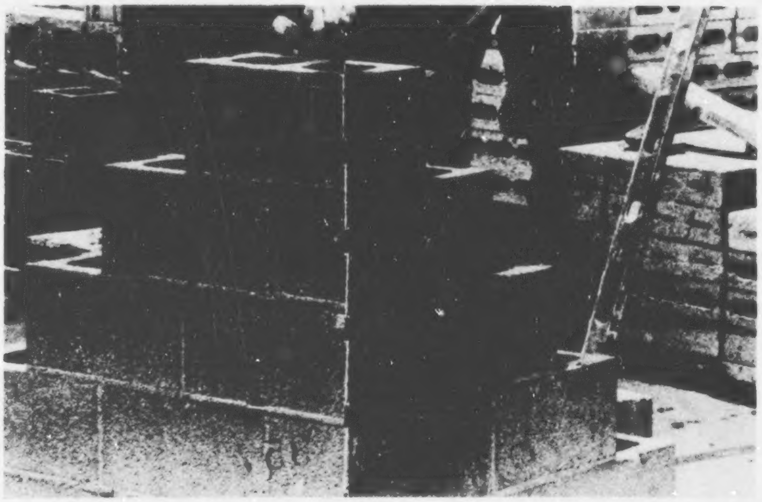
D. Checking alignment (in-line)

FIGURE 10



E. Checking course height

FIGURE 11



## INFORMATION SHEET

XIII. Bricklaying safety rules

A. Always cut masonry away from other workers

B. Wear proper protective clothing and safety equipment when using masonry saw

C. Always replace mortar carefully on mortarboard or in tub; never throw it so that it will splash

D. Keep tools out of path of other people

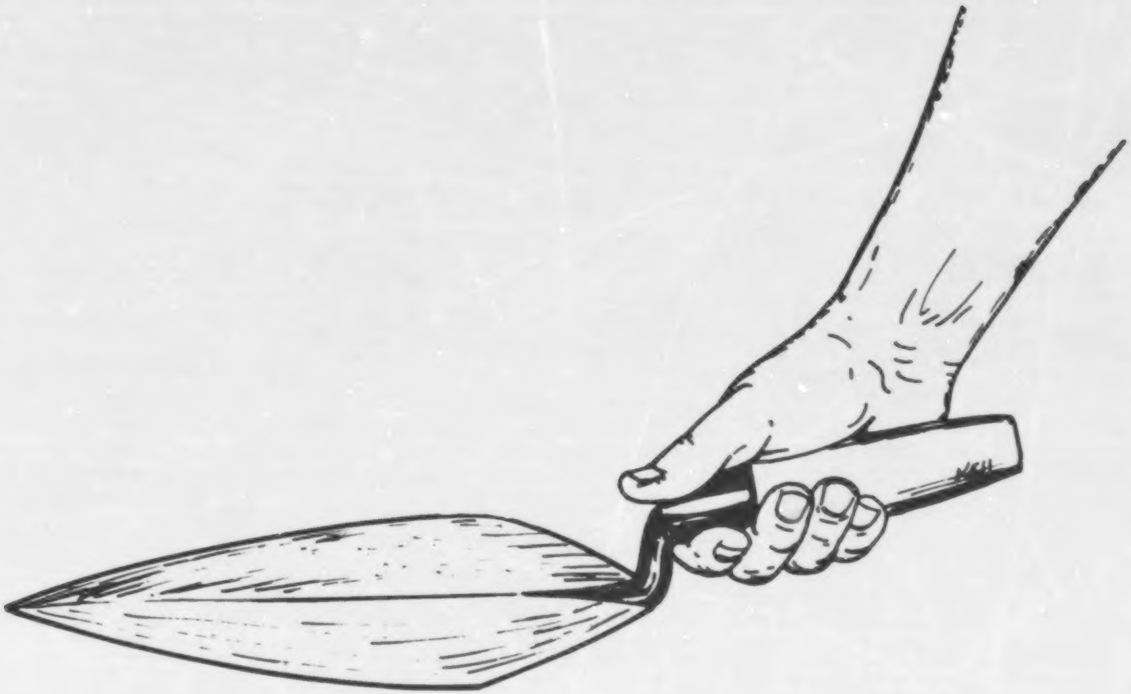
E. Always hand tools or materials to other person; never throw them

F. Use proper tool for job, and practice good tool habits as skills are learned

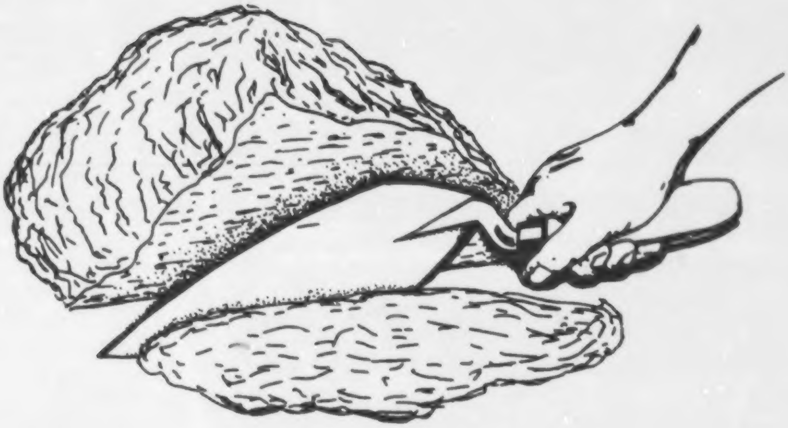
G. Lift heavy objects properly

H. Follow OSHA regulations

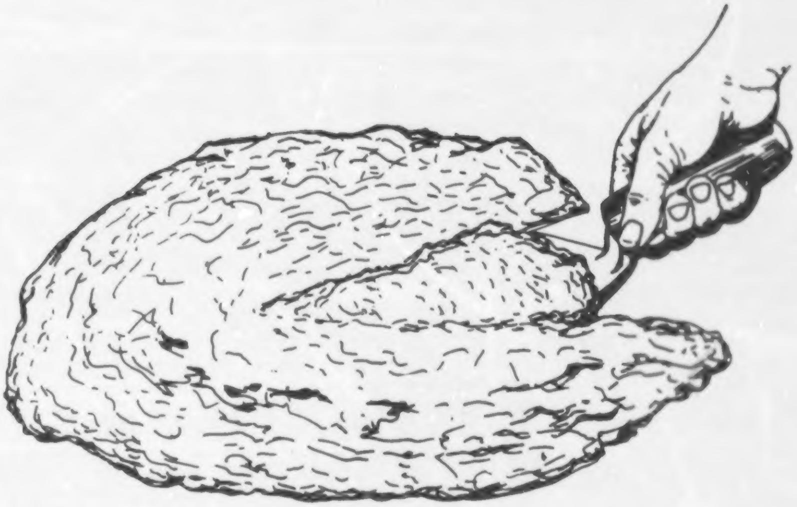
# Correct Way to Hold a Brick Trowl



# Methods of Picking Up Mortar

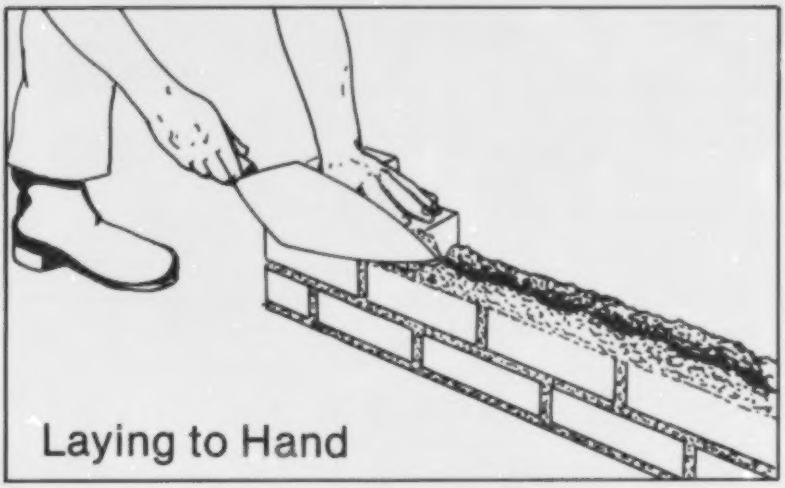


Cupping Method
(From the Side)

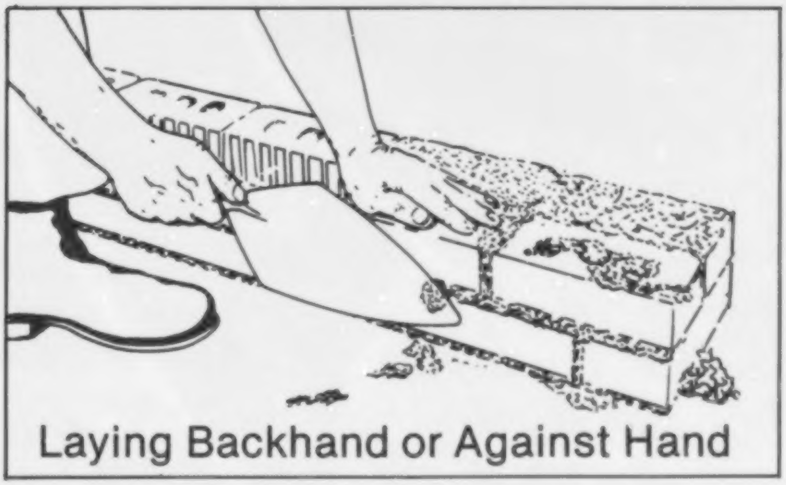


Clock Method
(From the Middle)

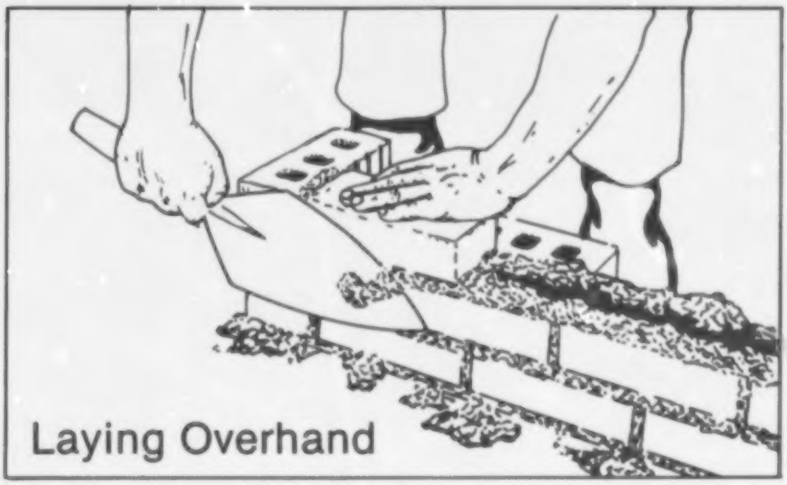
# Direction of Travel When Laying Brick



Laying to Hand



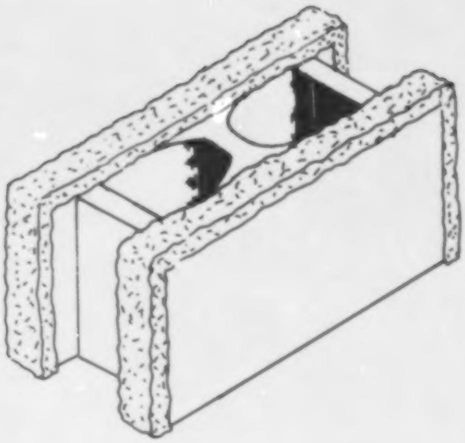
Laying Backhand or Against Hand



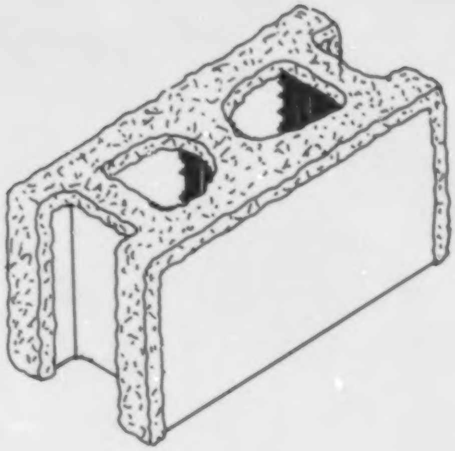
Laying Overhand

# Types of Bedding

## Block

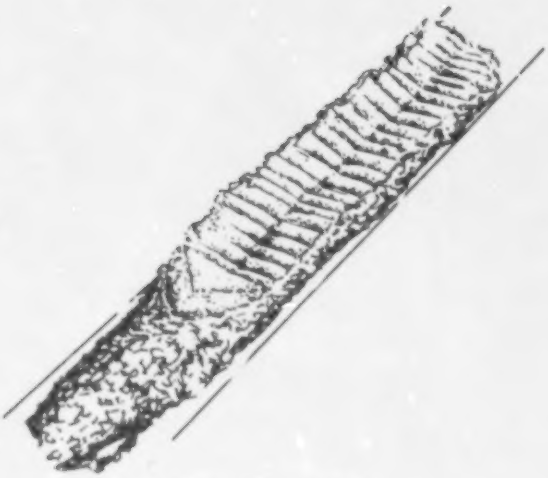


Face Shell

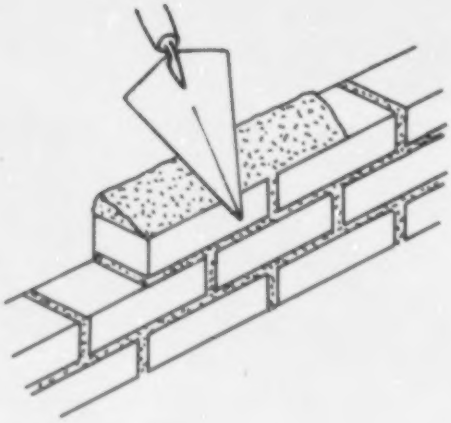


Full Mortar

## Brick



Furrowed



Tapered or Beveled

# SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## JOB SHEET #1 — SPREAD MORTAR ON A TWO-BY-FOUR

I. Equipment and materials

   A. Brick trowel

   B. Mortarboard and stand

   C. Laboratory mortar

   D. Bucket of water

   E. Shovel

   F. Two-by-four

II. Procedure

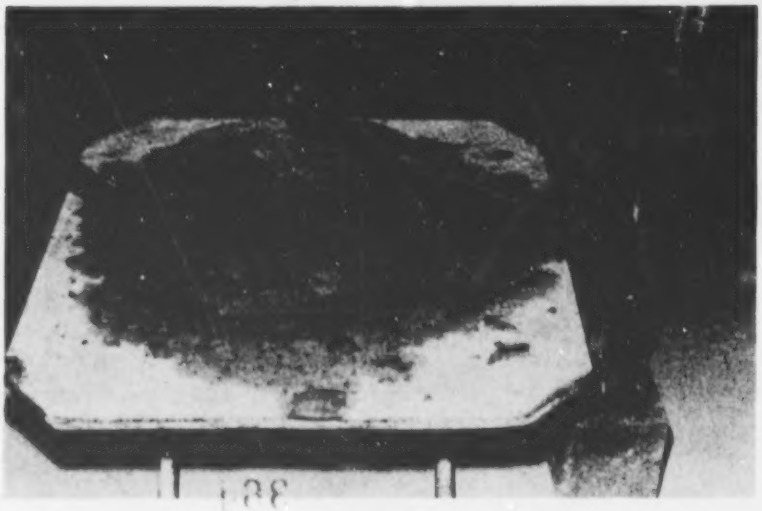
   (NOTE: When laying units, keep walls as clean as possible to be more economical and to make cleanup easier.)

   A. Position mortarboard on stand

   B. Wet mortarboard

   C. Place mortar in center of board (Figure 12)

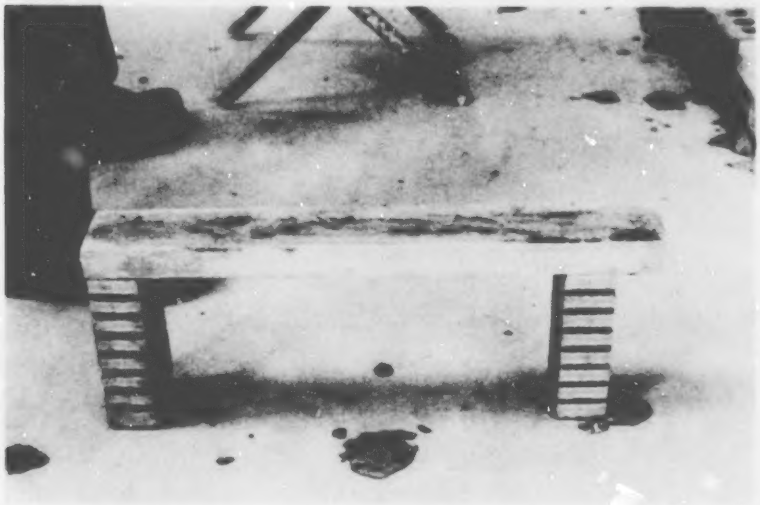
FIGURE 12



## JOB SHEET #1

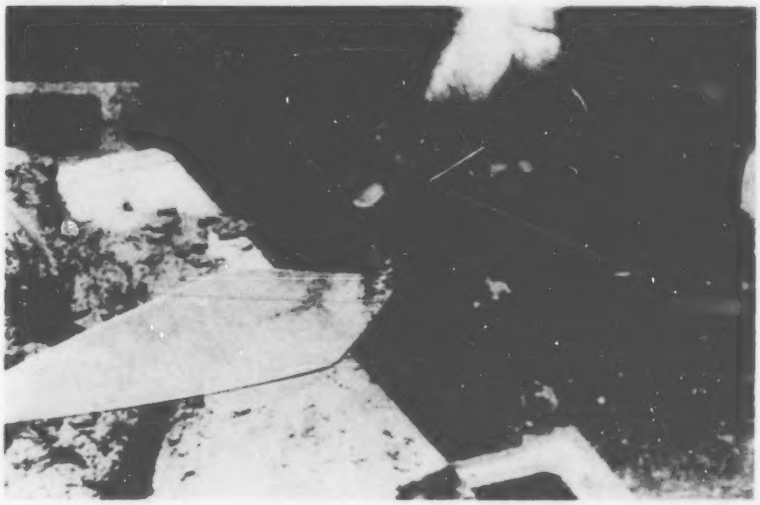
D. Place two-by-four approximately 2 feet from mortarboard (Figure 13)

FIGURE 13



E. Pick up trowel; hold trowel firmly but with a relaxed grip (Figure 14)

FIGURE 14



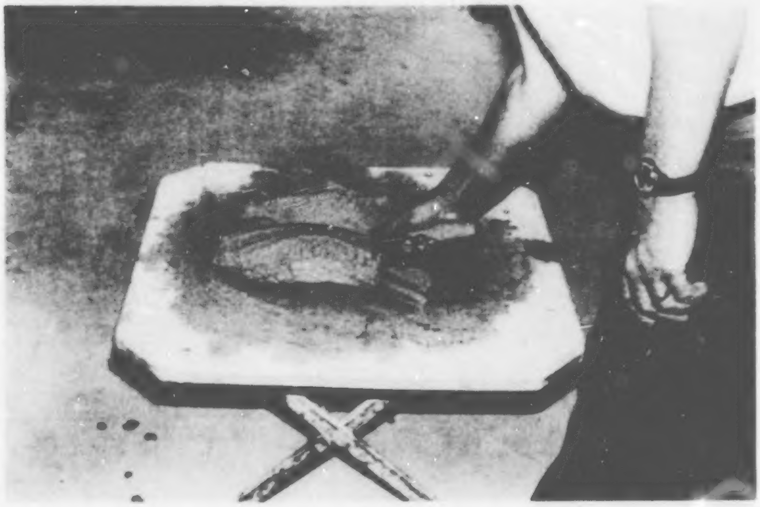
## JOB SHEET #1

F. Move trowel in hand until it feels comfortable and proper grip and movement are obtained

G. Cut out a trowel of mortar from side of mortarboard (Figure 15)

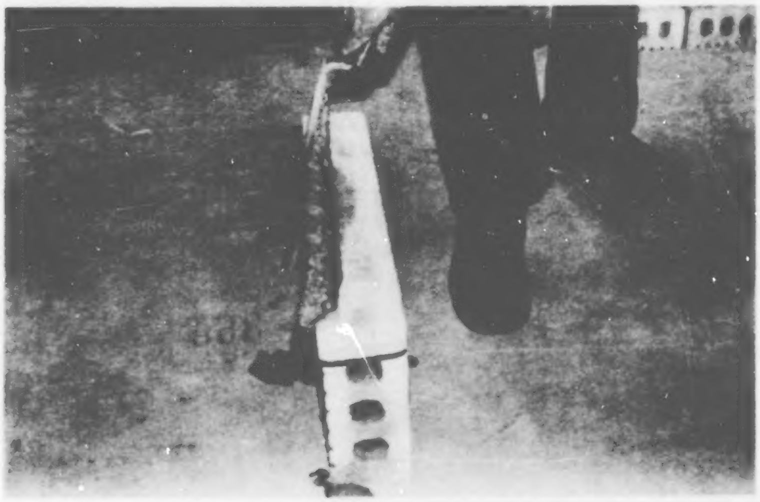
(NOTE: Repeat steps E through G until you have the feel of the trowel containing mortar.)

FIGURE 15



H. Pick up a trowel of mortar, and spread about 16 inches of mortar on two-by-four (Figure 16)

FIGURE 16

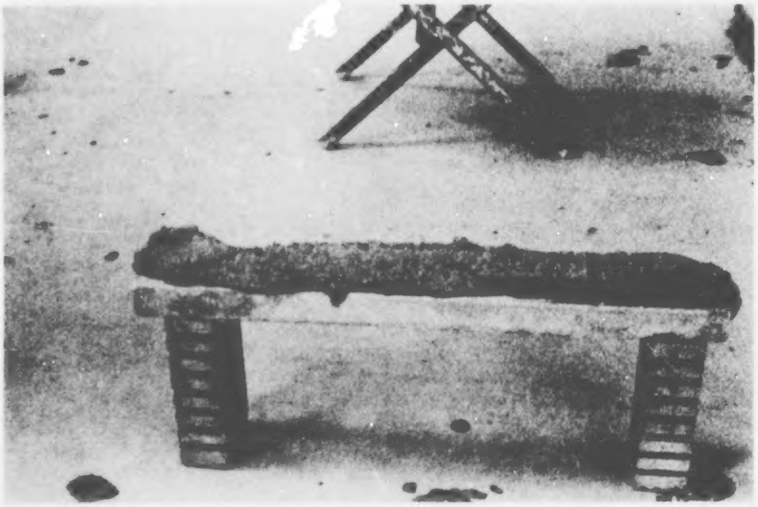


## JOB SHEET #1

I. Continue picking up mortar and spreading it on two-by-four until two-by-four is covered (Figure 17)

(NOTE: Avoid waste and keep the mortar thickness constant.)

FIGURE 17



J. Spread a solid bed joint with little or no furrowing

K. When bed joint is spread satisfactorily, have instructor evaluate

L. Remove mortar and place on mortarboard

M. Temper mortar if needed to keep same consistency

N. Clean trowel

O. Repeat procedure

P. Clean work area; clean and put away all tools and equipment

## SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## JOB SHEET #2 — SWIPE MORTAR ON A TWO-BY-FOUR FOR BLOCK

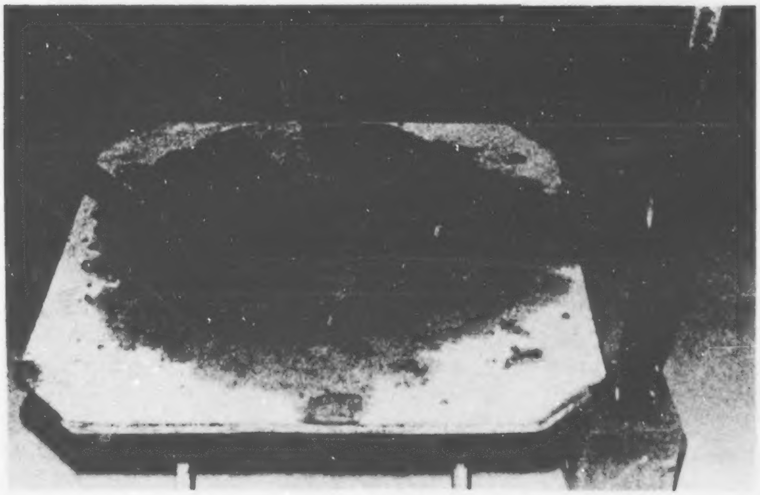
I. Equipment and materials

- A. Brick trowel
- B. Mortarboard and stand
- C. Laboratory mortar
- D. Bucket of water
- E. Two-by-four
- F. Shovel

II. Procedure

- A. Position mortarboard on stand
- B. Wet mortarboard
- C. Place mortar in center of board (Figure 18)

FIGURE 18



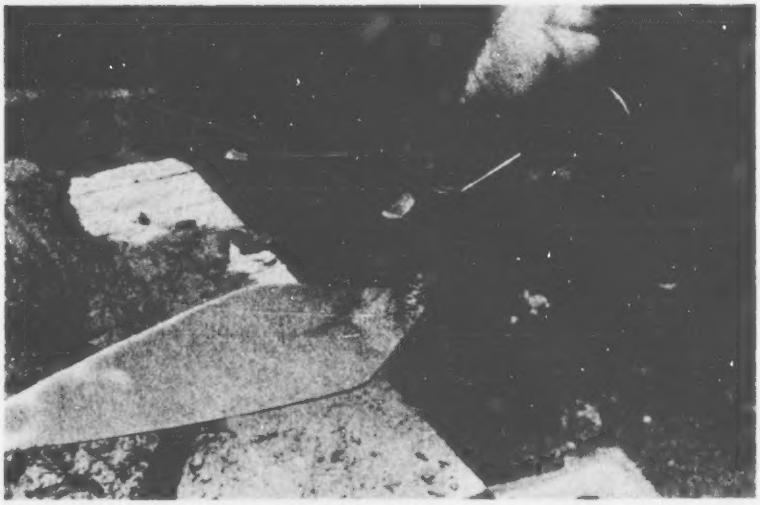
## JOB SHEET #2

D. Place two-by-four approximately 2 feet from mortarboard (Figure 19)

FIGURE 19

E. Pick up trowel; hold trowel firmly but with a relaxed grip (Figure 20)

FIGURE 20



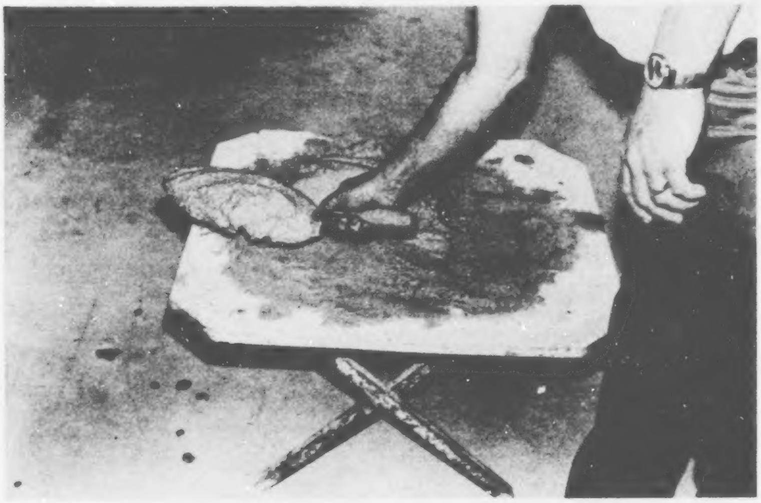
## JOB SHEET #2

F. Move trowel in hand until it feels comfortable and proper grip and movement are obtained

G. Cut out a trowel of mortar from side of mortarboard (Figure 21)

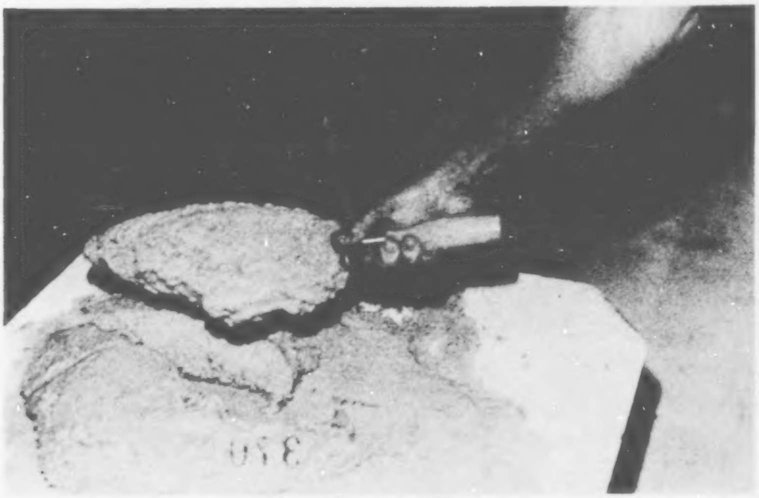
(NOTE: Repeat steps E through G until you have the feel of the trowel containing mortar.)

FIGURE 21



H. Take a trowel full of mortar from board, shaking trowel with a quick vertical snap of the wrist to make mortar stick to trowel (Figure 22)

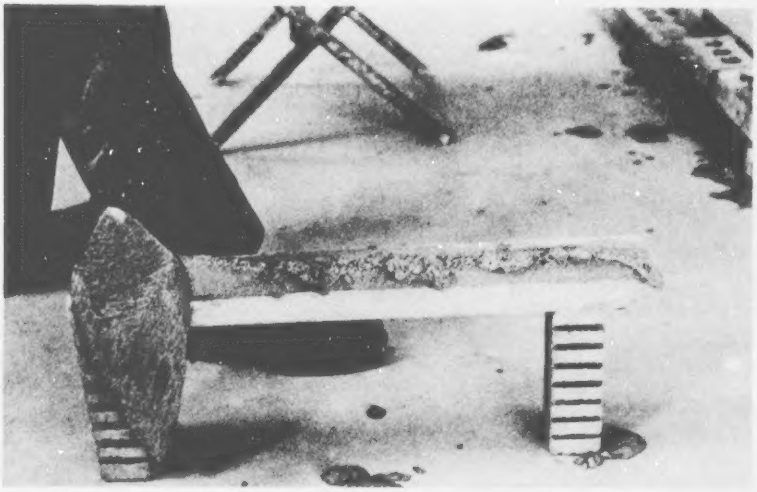
FIGURE 22



## JOB SHEET #2

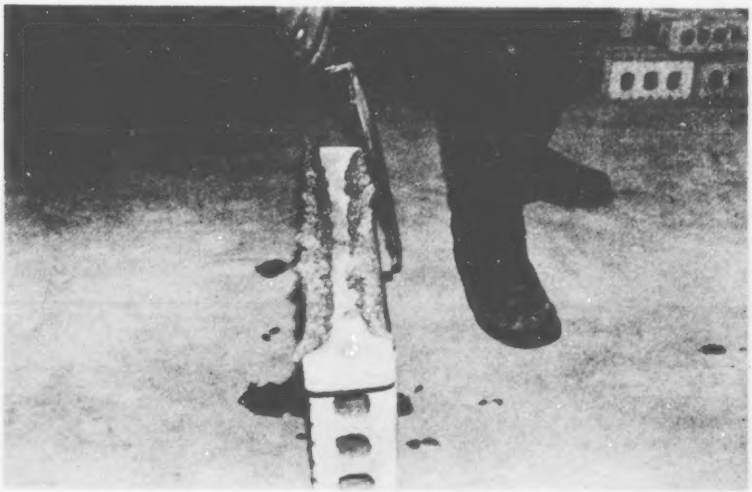
I. Swipe mortar on two-by-four for face shell bedding, leaving only enough mortar for 1-inch thickness (Figure 23)

FIGURE 23



(NOTE: Swipe mortar on outside edges of two-by-four. See Figure 24.)

FIGURE 24



## JOB SHEET #2

J. Swipe a solid bed of mortar 1 inch thick, making a minimum number of trips to mortarboard

(NOTE: In some areas, specifications call for full bedding.)

K. When bed joint has been spread satisfactorily, have instructor evaluate

L. Remove mortar and place on mortarboard

M. Temper mortar if needed to keep the same consistency

N. Clean trowel

O. Repeat procedure

P. Clean work area; clean and put away all tools and equipment

## SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## JOB SHEET #3 — LAY BLOCK TO ESTABLISHED LEADS

I. Equipment and materials

   A. Brick trowel

   B. Brick hammer

   C. Mortarboard and stand

   D. Modular rule

   E. Laboratory mortar

   F. 5-gallon pail

   G. Mason's line

   H. Line blocks

   I. Soft brush

   J. Shovel

   K. Approximately 50 8-inch blocks

   L. Jointer

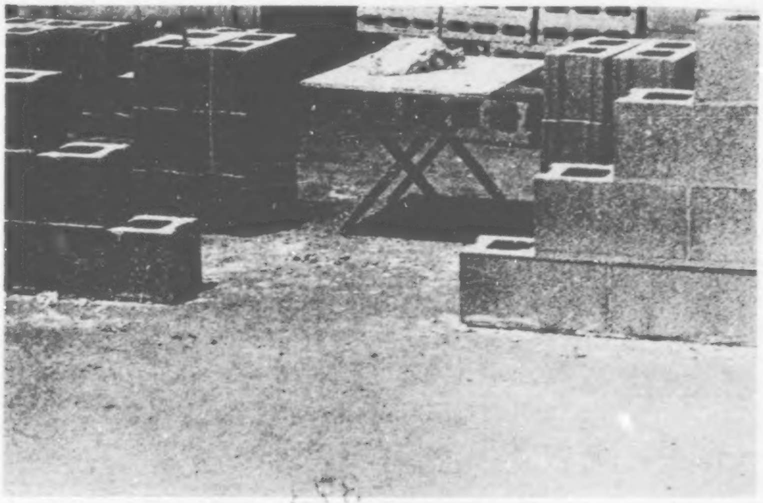
   M. Heavy-duty marking pencil

II. Procedure

   A. Secure mason's line for first course using line blocks; make sure that line is tight and has no sag (Figure 25)

   (NOTE: Use line pins or line holders if no corners are available.)

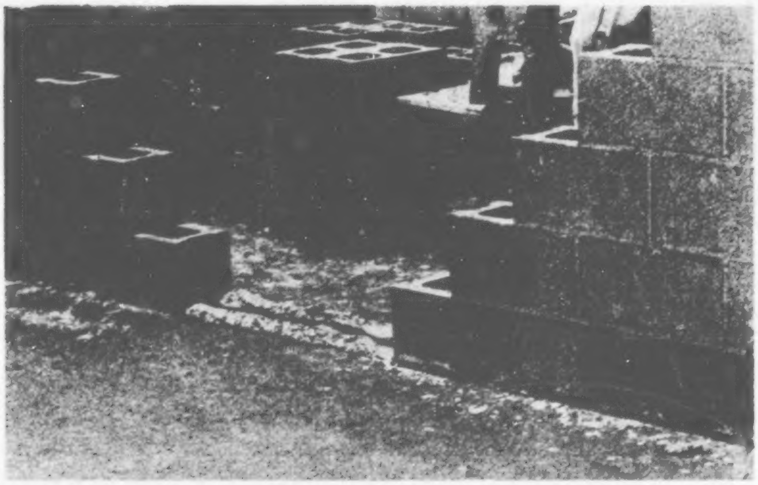
FIGURE 25



## JOB SHEET #3

B. Spread mortar bed for blocks, keeping mortar about $^{3}/_{4}$ inch thick (Figure 26)

FIGURE 26



C. Apply mortar to block for head joint (Figures 27 and 28)

FIGURE 27

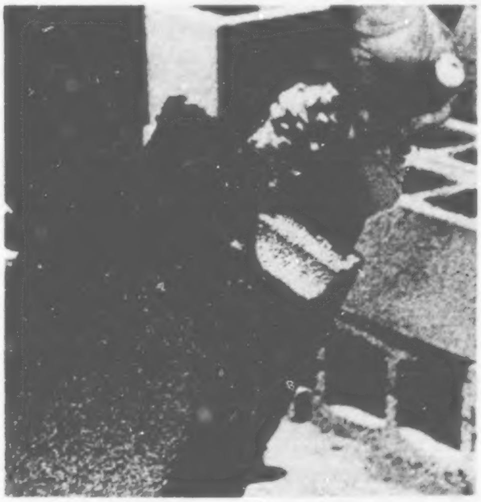
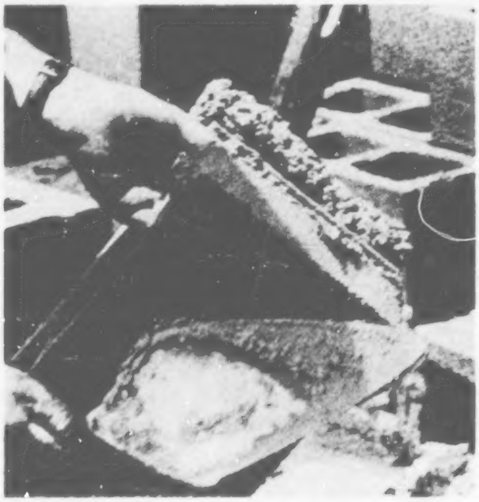


FIGURE 28



D. Pick up block and place gently on mortar bed, aligning end of block with dry bond marks on floor

## JOB SHEET #3

E. Apply pressure with hand, keeping top of block at top of mason's line and bottom face of block at chalk line on floor

(NOTE: Make sure that you can see daylight between face of block and line.)

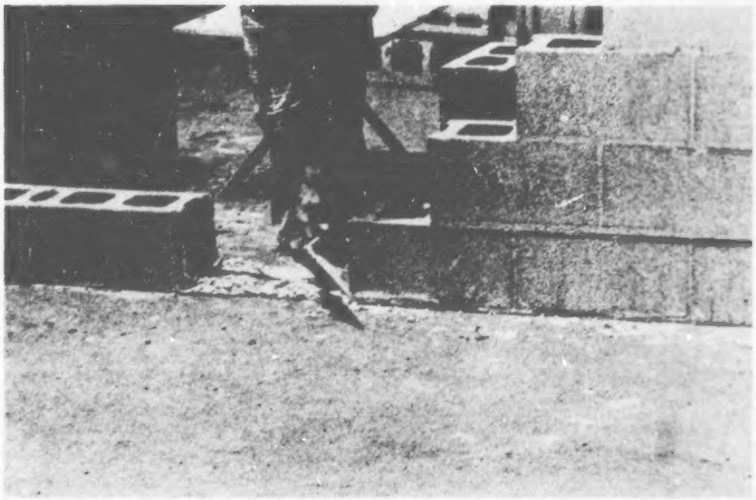
F. Place second block, using the same procedures used for previous block

G. Cut off mortar at head and bed joints

H. Lay closure block, or the last block to be laid to the line

1. Apply mortar to head joints of blocks laid to line; apply mortar to head joints of block to be laid (Figure 29)

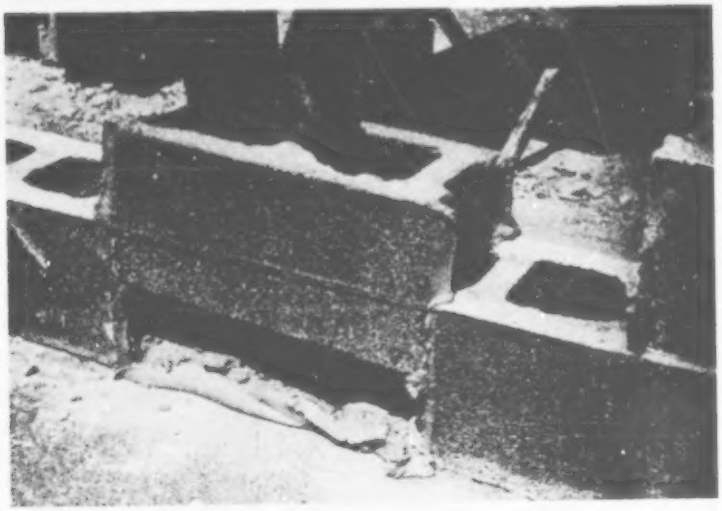
FIGURE 29



JOB SHEET #3

2. Pick up block and place it carefully so that mortar on head joints will not fall off (Figure 30)

FIGURE 30



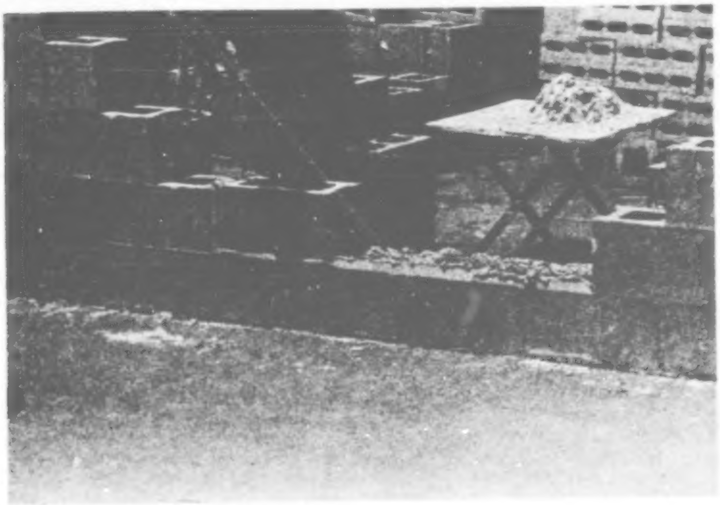
I. Lay second course

1. Raise line blocks to second course, making sure that mason's line is even with top of block on lead

   (NOTE: Make sure that line is tight and has no sag.)

2. Place mortar on face shells for second course (Figures 31-33)

FIGURE 31



## JOB SHEET #3

FIGURE 32

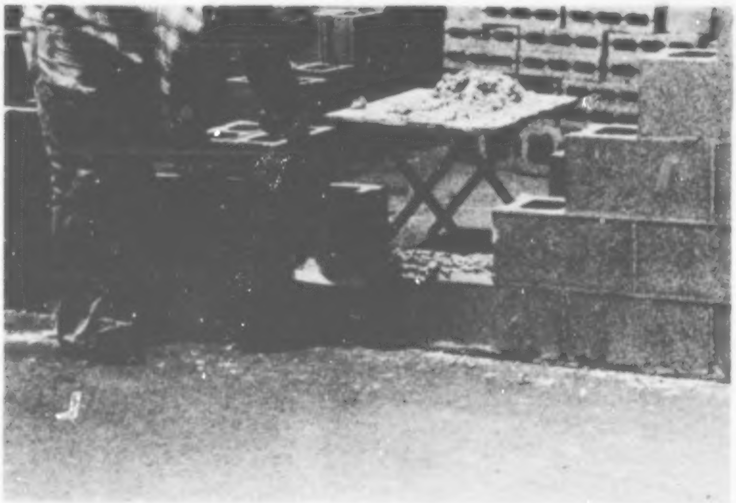
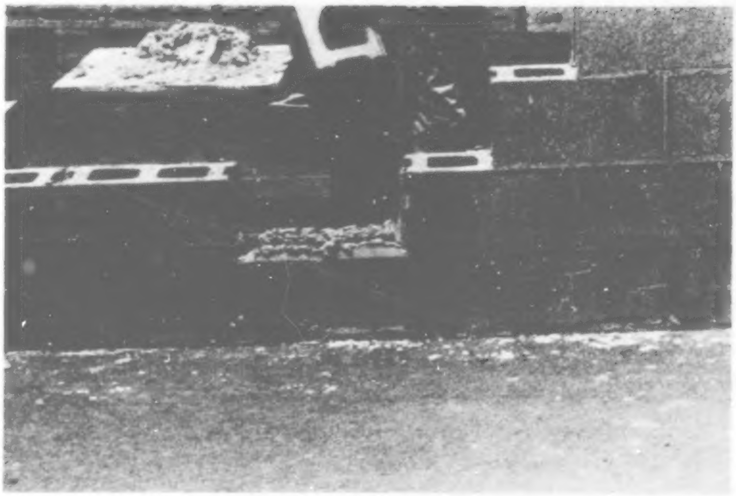


FIGURE 33



## JOB SHEET #3

3. Apply mortar to block for head joint

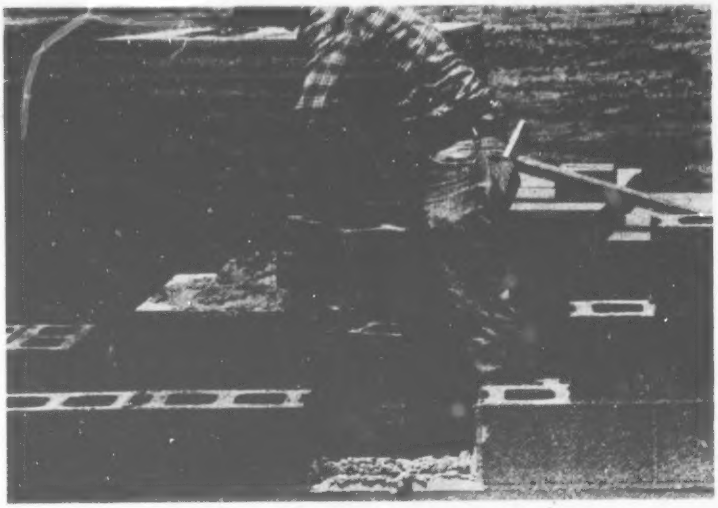
4. Pick up block and with a shoving motion place it gently on mortar bed, keeping a 3/8-inch head joint

5. Apply pressure to top of block, keeping top of block at top of line and bottom face of block on same plane as top face of the course below

   (NOTE: Be sure that you can see daylight between face of block and line.)

J. Continue laying block to line, making sure block is on half bond, until you reach closure block, or last block to be laid to the line (Figure 34)

FIGURE 34

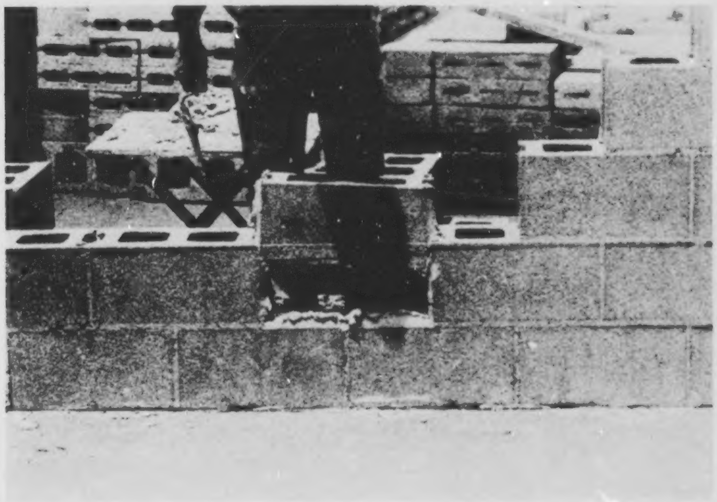


## JOB SHEET #3

K. Lay closure block, using same procedures used to lay closure block on first course (Figure 35)

(NOTE: Check the blocks laid to the line to make sure that they are in perfect alignment.)

FIGURE 35



## JOB SHEET #3

L. Continue laying blocks to height of leads

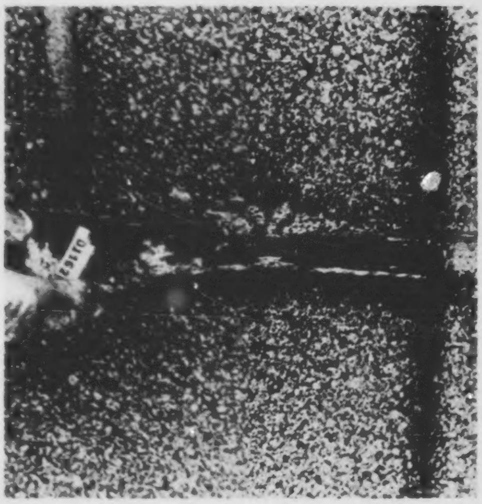
1. Make sure that line is tight and has no sag
2. Keep top of block at top of line and on same plane as course below

   (NOTE: Be sure that you can see daylight between face of block and line.)

3. Remember to cut off mortar from head and bed joints on both sides of wall
4. Strike joints with concave jointer as needed (Figures 36 and 37)

FIGURE 36

FIGURE 37



5. Clean units
6. Restrike joints

M. Clean up area around wall

N. Clean and put away all tools and equipment

# SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## JOB SHEET #4 — BUILD A 90-DEGREE BLOCK LEAD

I. Equipment and materials

A. Steel tape

B. Bricklayer's modular rule

C. Marking pencil

D. Chalk line

E. Framing square

F. Brick trowel

G. Brick hammer

H. 4-foot level

I. Concave jointer

J. Dusting brush

K. Story pole

L. Mortarboard and stand

M. Laboratory mortar

N. 5-gallon water bucket

O. Water

P. Square-point shovel

Q. 42 blocks

## JOB SHEET #4

II. Procedure

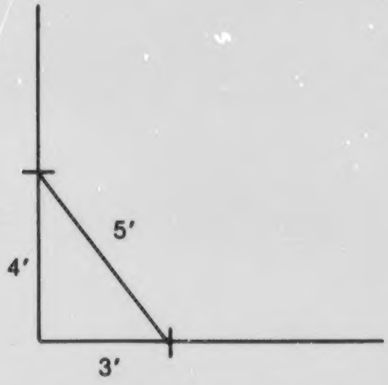
(NOTE: The instructor should designate starting point.)

A. Chalk wall lines on floor (Figure 38)

FIGURE 38

B. With steel tape, check squareness of chalk lines using the 3′ × 4′ × 5′ method (Figure 39)

FIGURE 39

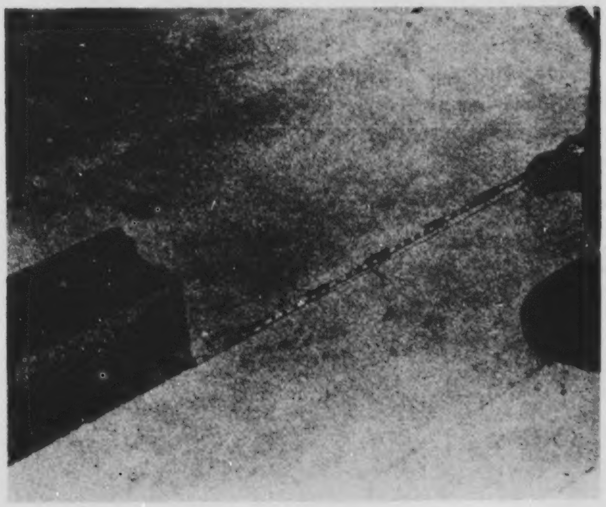


C. Have instructor evaluate

## JOB SHEET #4

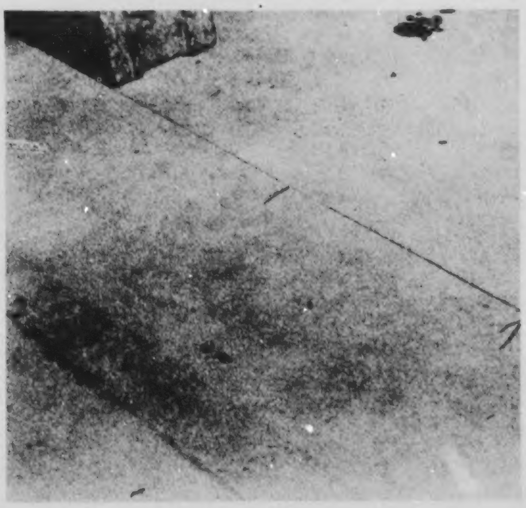
D. Lay out dry bond for wall (Figure 40)

FIGURE 40



E. Mark on floor location of ends of each block (Figure 41)

FIGURE 41



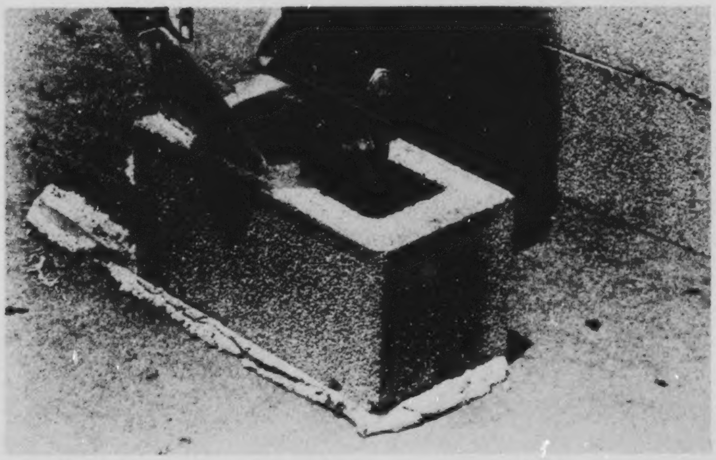
F. Remove dry bond by pushing blocks to outside so that you have enough room to lay corner leads

## JOB SHEET #4

G. Lay first course of blocks for a five-course lead

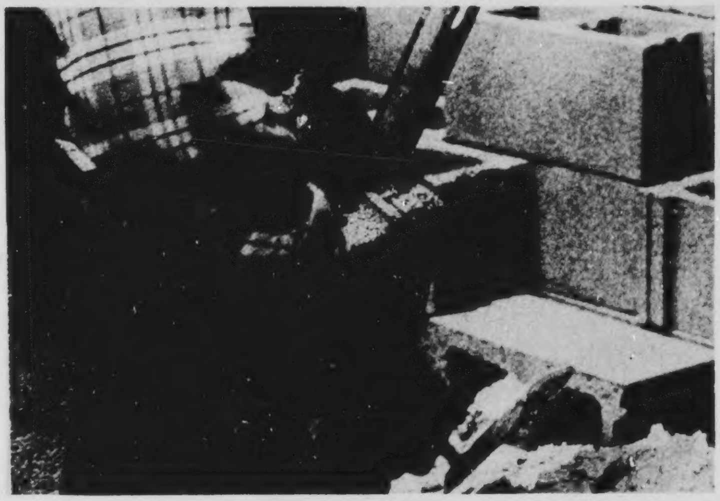
1. Spread enough bed mortar for three blocks, keeping mortar about ¾ inch thick
2. Pick up a block and place it firmly on mortar bed
3. Apply slight pressure with hand, and make sure that bottom face of block is even with chalk lines on floor (Figure 42)

FIGURE 42



4. Check height of block with modular rule
5. Level block
6. Apply mortar to second block for head joint (Figure 43)

FIGURE 43



## JOB SHEET #4

7. Place second block gently on mortar bed, maintaining a $^3/_8$-inch head joint and keeping bottom face of block even with chalk line on floor

   (NOTE: Remember to cut off mortar from head and bed joints.)

8. Apply mortar for head joint and lay third block

9. Use 4-foot level to level blocks; check face of block for plumb and alignment (Figures 44 and 45)

FIGURE 44

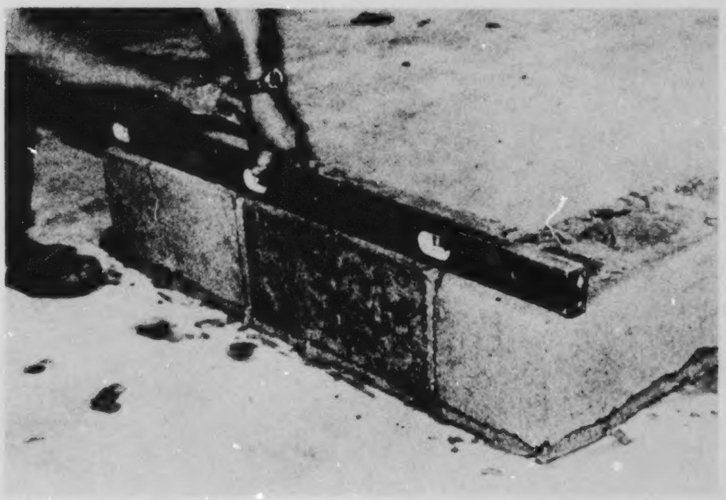
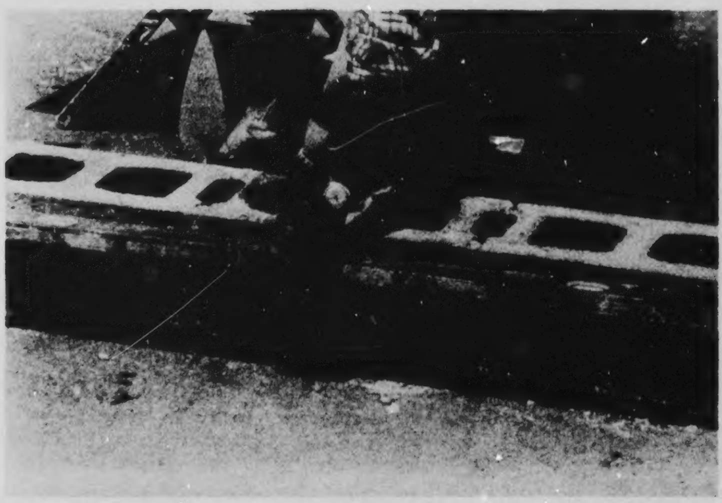


FIGURE 45



## JOB SHEET #4

10. Use same procedures to spread mortar and lay blocks at return of lead

    (NOTE: Be sure to keep head joints filled, blocks level, plumb, on course height, and even with chalk lines on floor.)

11. Strike joints if needed and clean up mortar on floor

H. Start second block course by placing mortar on face shells; keep blocks level, plumb, aligned and on course height (Figures 46 and 47)

FIGURE 46

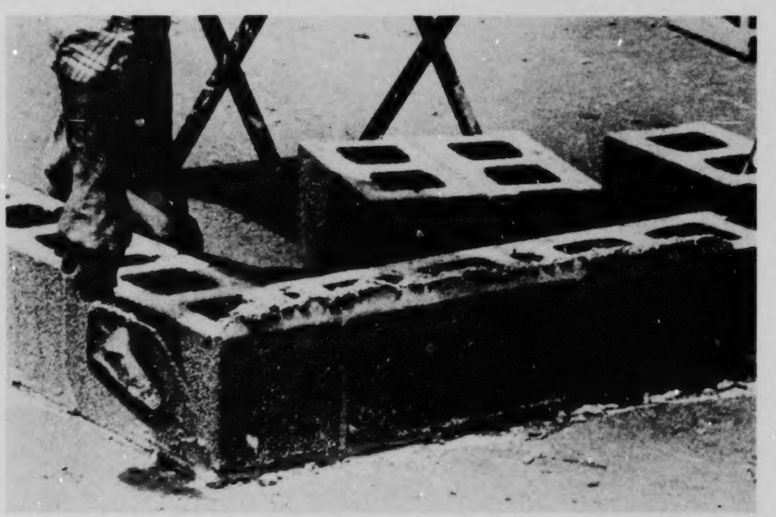
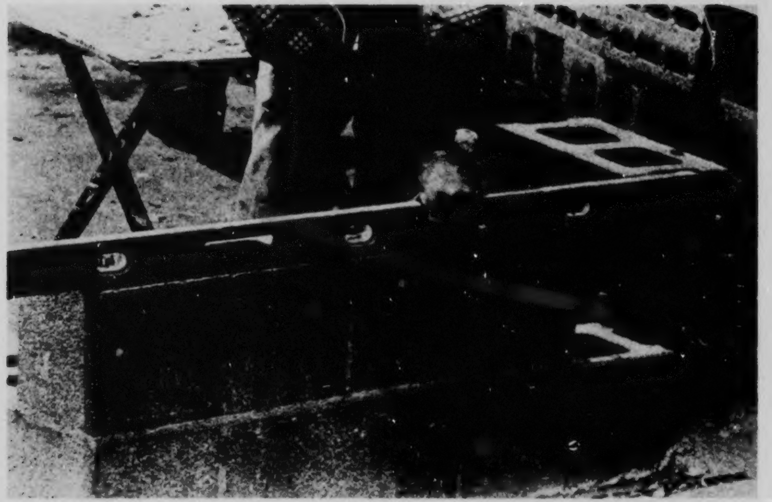


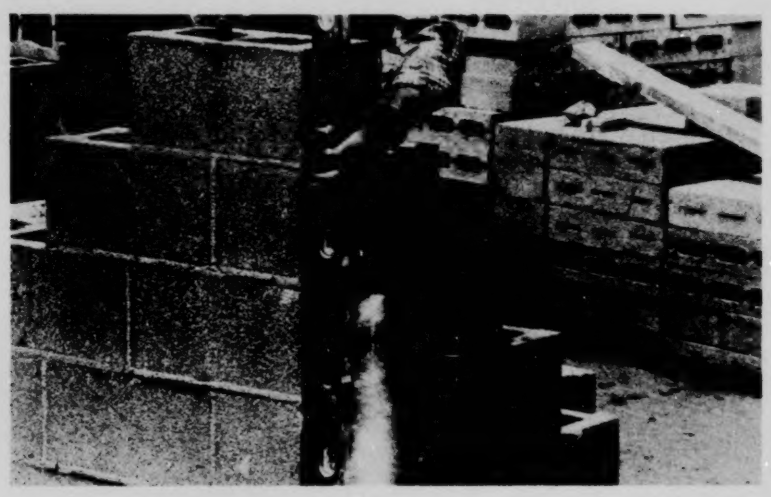
FIGURE 47



## JOB SHEET #4

I. Continue building lead to a height of five courses (40 inches) (Figure 48)

FIGURE 48



J. Check level, plumb, alignment, rack, and course height of corner lead

K. Strike, brush, and restrike joints

L. Clean up floor at base of lead

M. Clean and put away all tools and equipment

# SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## JOB SHEET #5 — SPREAD MORTAR ON A TWO-BY-FOUR FOR BRICK

I. Equipment and materials

  A. Brick trowel

  B. Mortarboard and stand

  C. Laboratory mortar

  D. Bucket of water

  E. Two-by-four

  F. Shovel

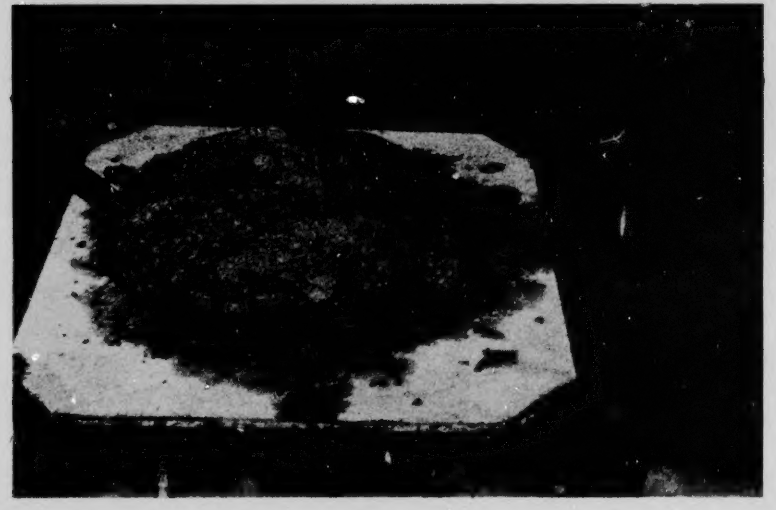
II. Procedure

  A. Position mortarboard on stand

  B. Wet mortarboard

  C. Place mortar in center of board (Figure 49)

FIGURE 49



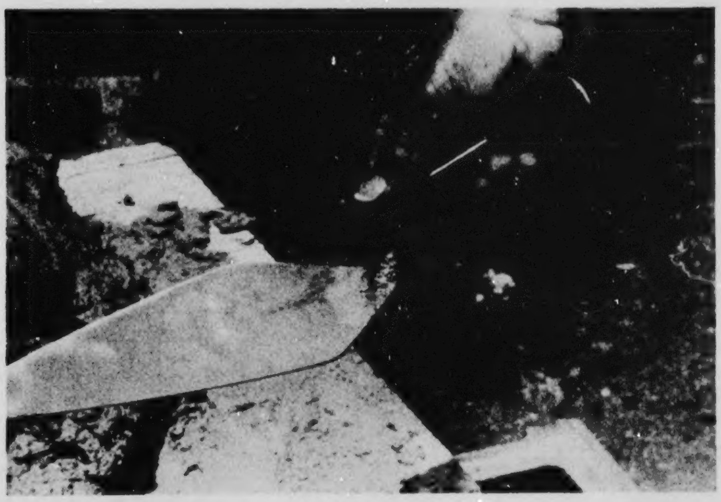
JOB SHEET #5

D. Place two-by-four approximately 2 feet from mortarboard (Figure 50)

FIGURE 50

E. Pick up trowel; hold trowel firmly but with a relaxed grip (Figure 51)

FIGURE 51



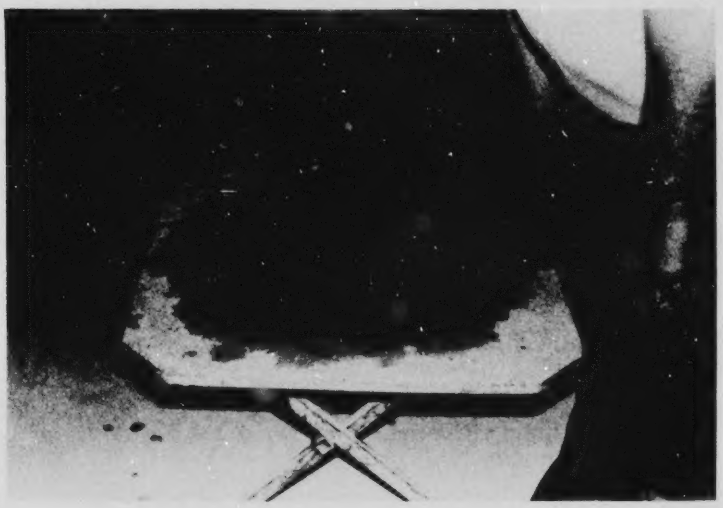
## JOB SHEET #5

F. Move trowel in hand until it feels comfortable and proper grip and movement are obtained

G. Cut out a trowel of mortar from side of mortarboard (Figure 52)

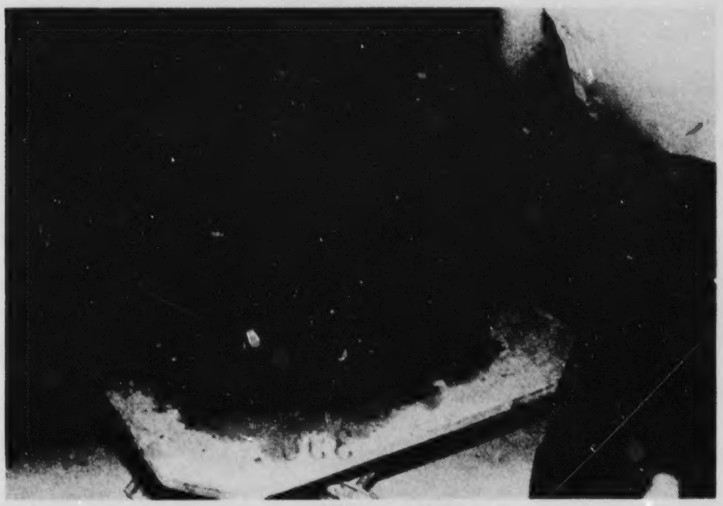
(NOTE: Repeat steps E through G until you have the feel of the trowel containing mortar.)

FIGURE 52



H. Take trowel full of mortar from board, shaking trowel with a quick vertical snap of the wrist to make mortar stick to trowel (Figure 53)

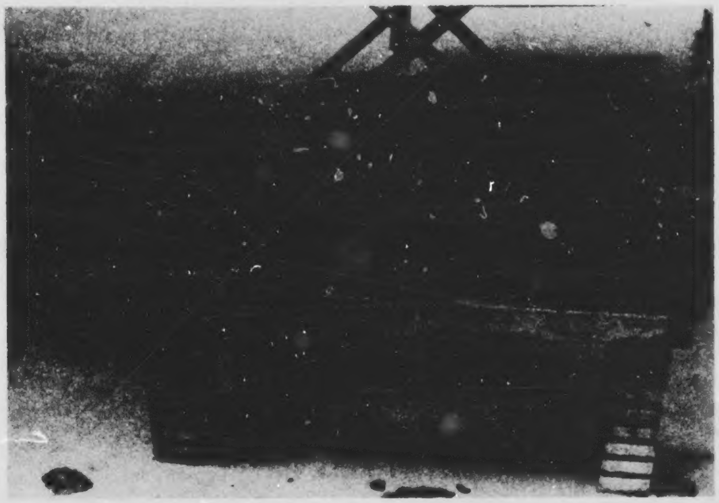
FIGURE 53



## JOB SHEET #5

I. Place mortar on two-by-four for bed joint, leaving only enough mortar for 1-inch thickness (Figure 54)

FIGURE 54



J. Spread a solid bed of mortar 1 inch thick, making a minimum number of trips to mortarboard

K. After bed mortar is spread satisfactorily, have instructor evaluate

L. Remove mortar and place on mortarboard

M. Temper mortar if needed to keep the same consistency

N. Clean trowel

O. Repeat procedure

P. Clean work area; clean and put away all tools and equipment

# SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## JOB SHEET #6 — LAY BRICK TO ESTABLISHED LEADS

I. Equipment and materials

A. Brick trowel

B. Brick hammer

C. Jointer

D. Mortarboard and stand

E. Shovel

F. Laboratory mortar

G. Bucket of water

H. Mason's line

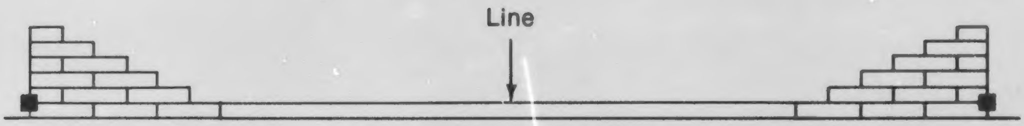
I. Line blocks

J. Approximately 90 bricks

II. Procedure

A. Secure mason's line using line blocks; make sure that line is tight and has no sag (Figure 55)

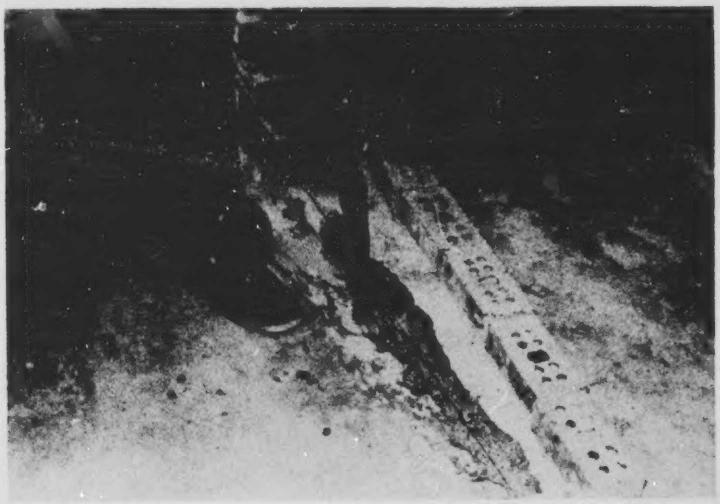
FIGURE 55



## JOB SHEET #6

B. Spread bed mortar for three or four bricks (Figure 56)

FIGURE 56



C. Pick up brick, and place enough mortar on end so that you will have a full head joint (Figure 57)

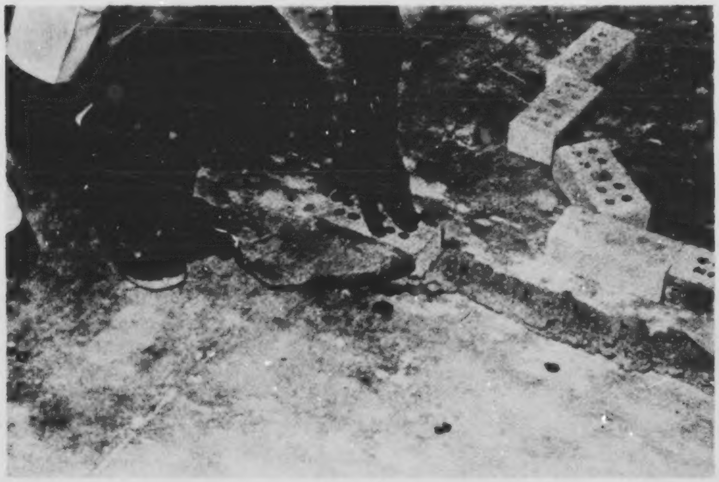
(NOTE: Make sure to keep ends of bricks even with dry bond marks on floor.)

FIGURE 57

## JOB SHEET #6

D. Apply pressure to top of brick, keeping top of brick even with top of line, and one thickness of the line away from the mason's line (Figure 58)

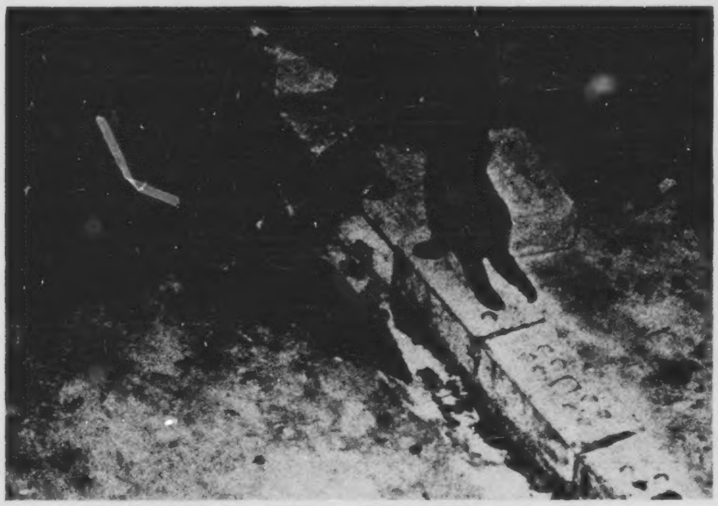
FIGURE 58



E. Cut mortar off head joint and bed joint at base of brick, and place it on end of brick just laid

(NOTE: This is done for each brick laid to the line. See Figure 59.)

FIGURE 59



## JOB SHEET #6

F. Continue laying brick to the line until you come to the closure brick or last brick to be laid

G. Lay closure brick

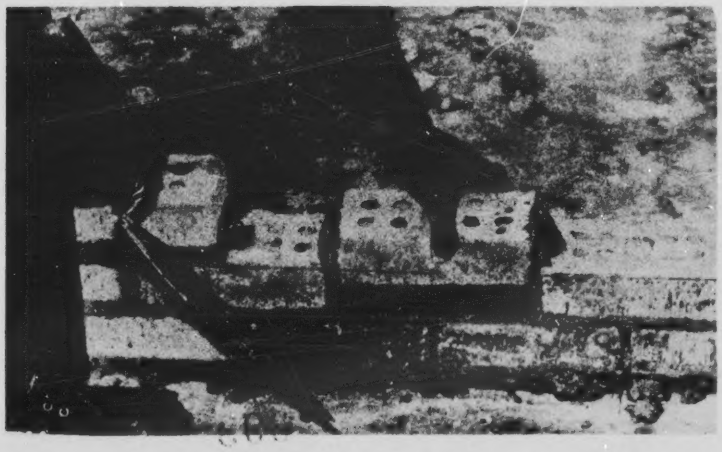
   1. Apply mortar to the ends of bricks already laid and both ends of brick to be laid (Figure 60)

FIGURE 60

   2. Press brick firmly into place, keeping top of brick even with top of line (Figure 61)

      (NOTE: Check bricks that have been laid to the line, making sure that tops of bricks are even with top of line and one thickness of the line away from the mason's line.)

FIGURE 61



## JOB SHEET #6

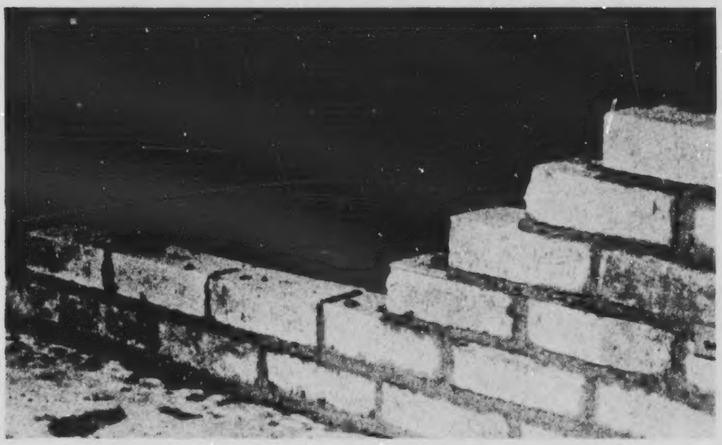
H. Raise line blocks for second course, making sure that line is even with top of brick on second course of leads

I. Spread mortar for three or four bricks and continue to lay bricks to the line, making sure to half bond bricks with those laid on first course (Figure 62)

FIGURE 62

(NOTE: The first two courses will establish the bond for the remaining courses to be laid. See Figure 63.)

FIGURE 63



## JOB SHEET #6

J. Raise line blocks for third course, making sure that line is tight and has no sag

   1. Lay bricks on third course

   2. Sight end of each brick with end of corresponding brick on first course

K. Continue to raise the line and lay brick to the line for the remaining courses (Figure 64)

   1. Spread mortar for three or four bricks

   2. Make sure head joints are filled solid

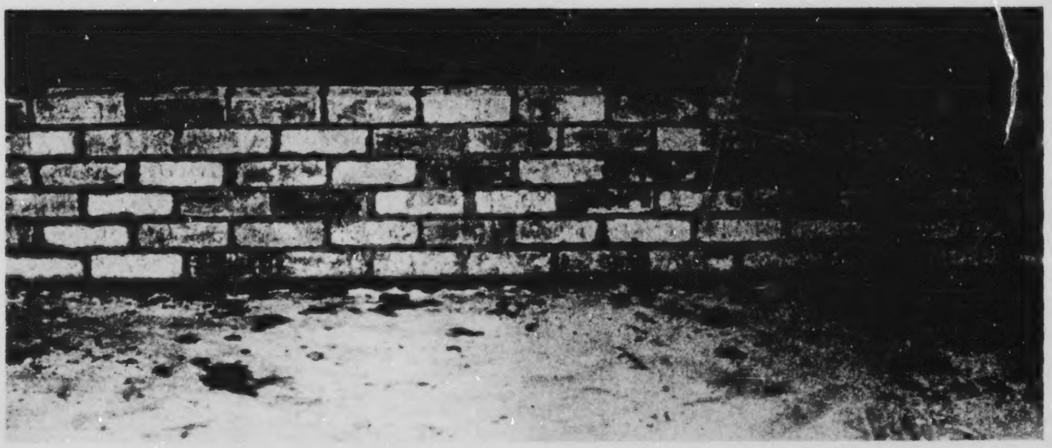
   3. Keep top of bricks even with top of line

   4. Make sure that you can see daylight between face of brick and line

   5. Sight ends of brick with courses below to maintain a plumb bond

   (NOTE: Keep mortar well tempered.)

FIGURE 64



## JOB SHEET #6

L. Hold jointer firmly in hand and strike head joints; then strike bed joints (Figures 65 and 66)

(NOTE: The jointer should be slightly larger than the mortar joints.)

FIGURE 65

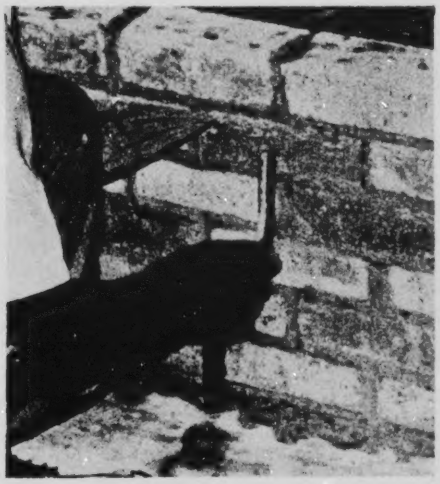
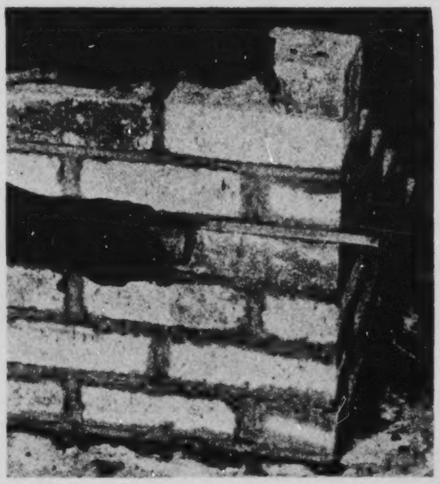


FIGURE 66



M. Clean work area; clean and put away all tools and equipment

# SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## JOB SHEET #7 — BUILD A 90-DEGREE BRICK LEAD

I. Equipment and materials

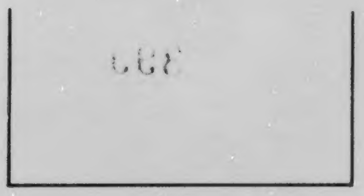
- A. Bricklayer's modular rule
- B. Brick trowel
- C. Brick hammer
- D. 4-foot level
- E. Dusting brush
- F. Concave jointer
- G. Shovel
- H. Framing square
- I. Chalk line
- J. Mortarboard and stand
- K. Laboratory mortar
- L. 5-gallon bucket
- M. Water
- N. 21 face bricks
- O. Story pole
- P. Marking pencil

II. Procedure

(NOTE: The instructor should designate starting point.)

A. Chalk wall lines on floor (Figure 67)

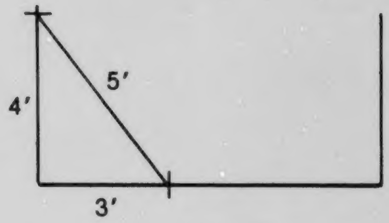
FIGURE 67



## JOB SHEET #7

B. With steel tape, check squareness of chalk lines using the 3′ × 4′ × 5′ method (Figure 68)

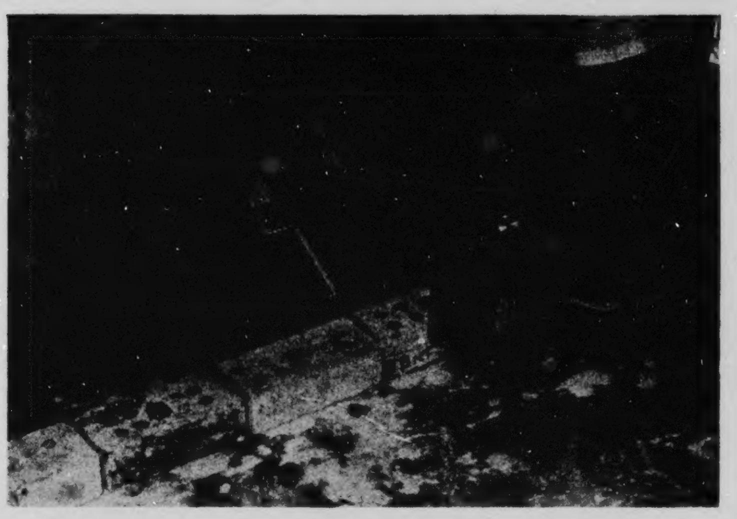
FIGURE 68



C. Have instructor evaluate

D. Lay out dry bond for wall (Figure 69)

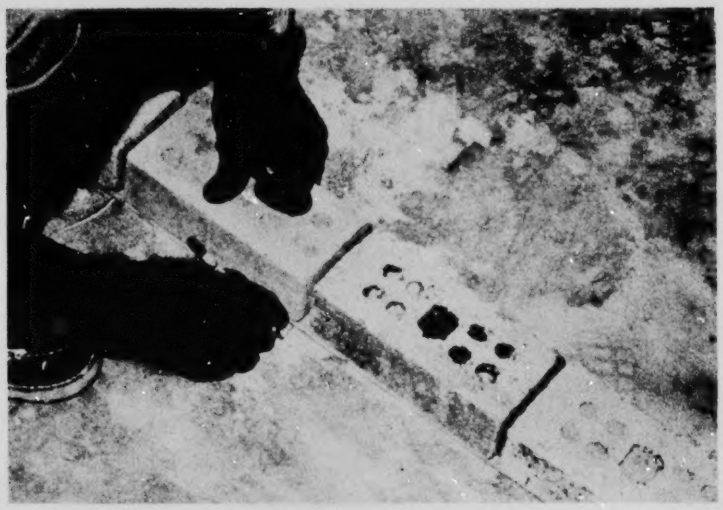
FIGURE 69



## JOB SHEET #7

E. Mark on floor location of ends of each brick (Figure 70)

FIGURE 70



F. Remove dry bond by pushing bricks to outside so that you have enough room to lay corner leads

G. Lay first course of bricks for a six-course lead

1. Spread enough bed mortar for three bricks
2. Pick up full brick and press it firmly on mortar bed, leaving a $^3/_8$-inch bed joint, and keeping face and end of brick even with chalk line on floor (Figure 71)

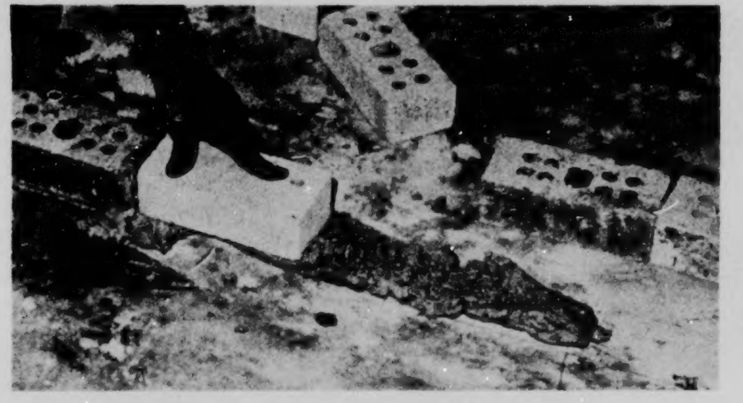
FIGURE 71

## JOB SHEET #7

3. Lay the two remaining bricks on lead by shoving brick into mortar and spreading enough mortar on end of brick to completely fill head joint (Figure 72)

   (NOTE: Remove mortar at base of bricks and make sure that bricks are even with chalk line and with dry bond marks on the floor.)

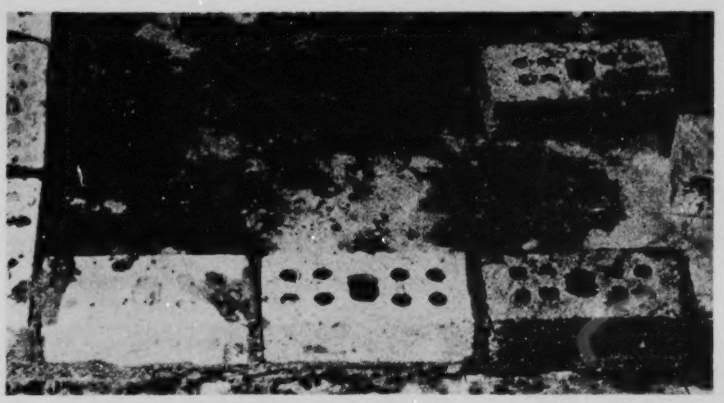
FIGURE 72



4. Spread mortar for three bricks at return of lead

5. Lay three bricks, keeping $^3/_8$-inch bed joint and solid head joints (Figure 73)

FIGURE 73



JOB SHEET #7

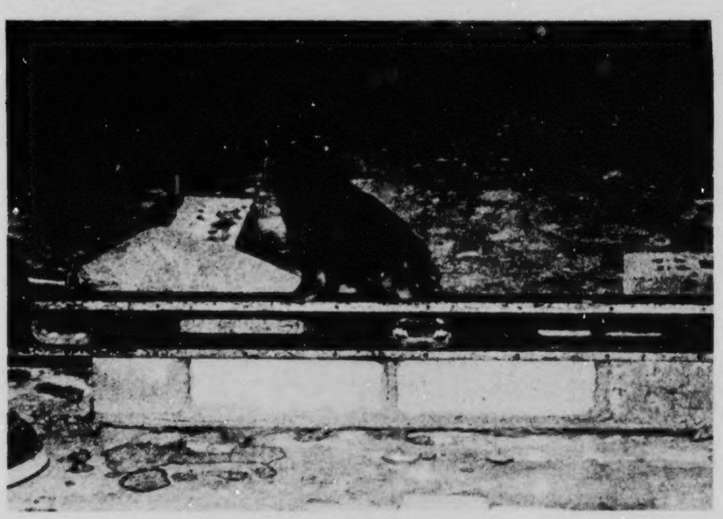
6. Remove mortar at base of bricks

   (NOTE: Make sure to align face of bricks with chalk line on floor.)

H. Set level on top of course laid, and check for levelness (Figure 74)

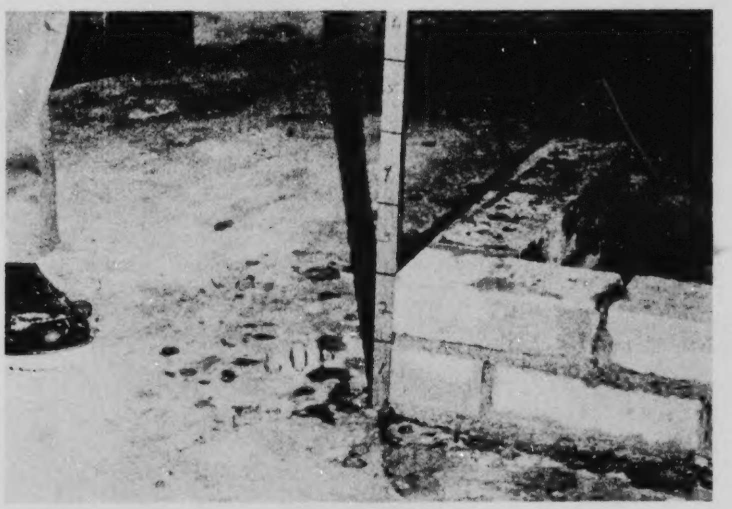
   (NOTE: If brick course is not level, tap brick slightly with trowel handle at high end.)

FIGURE 74



I. Use story pole to check course height (Figure 75)

FIGURE 75

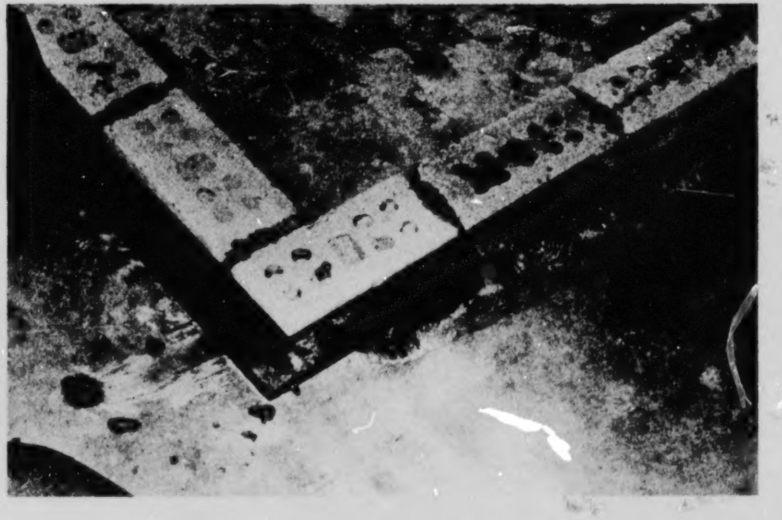


## JOB SHEET #7

J. Use framing square to check course squareness (Figure 76)

(NOTE: First course of lead should be flush with chalk lines and should be perfectly square.)

FIGURE 76



K. Lay second course of lead

1. Spread mortar for three bricks in second course of lead

## JOB SHEET #7

2. Lay bricks, keeping $^3/_8$-inch bed joint and solid head joints, and keeping face of brick even with brick face of first course (Figures 77 and 78)

   (NOTE: Be careful not to smear or stain face of bricks when cutting mortar from bed and head joints.)

FIGURE 77

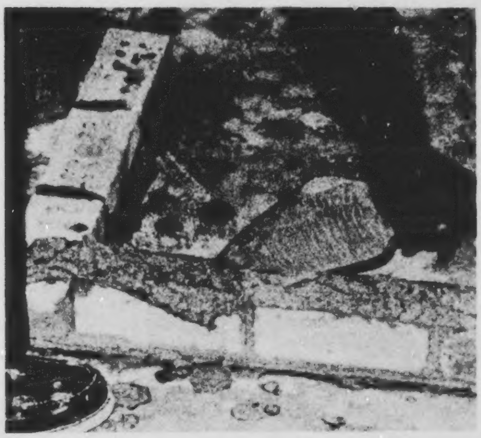
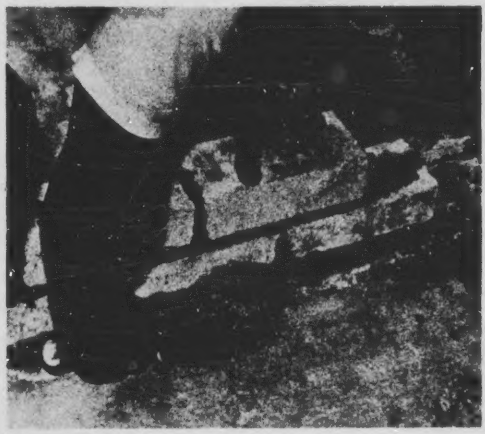


FIGURE 78



3. Spread mortar for two bricks in return of lead

4. Lay two bricks, keeping $^3/_8$-inch bed joint and solid head joints

L. Level the course just laid; use story pole to check course height (Figures 79 and 80)

FIGURE 79

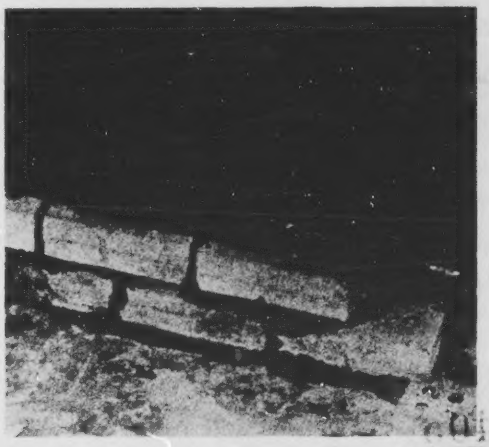
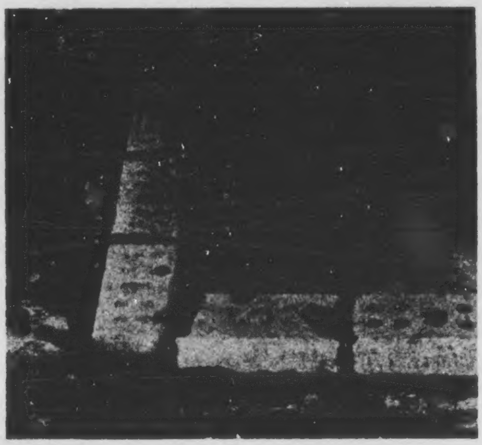


FIGURE 80



## JOB SHEET #7

M. Plumb corners on lead with level, making sure that they are perfectly plumb

N. Lay third course

   1. Spread mortar for two bricks for third course

   2. Lay bricks, keeping face of bricks even with face of bricks on second course

   3. Spread mortar for two bricks in return of lead; keep 3/8-inch bed joint and make sure that head joints are filled solid

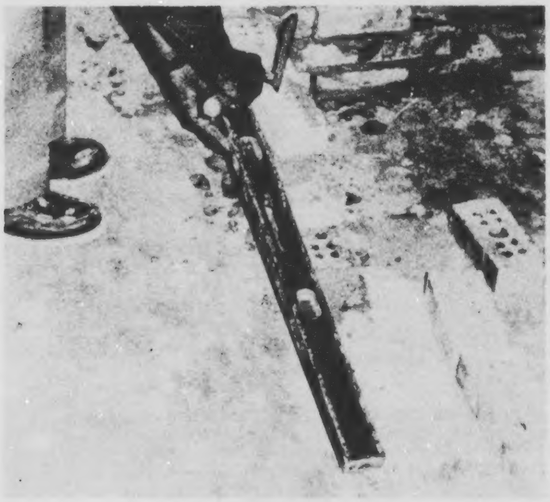
O. Level course

P. Check course height with story pole

Q. Plumb corners

R. Check range at both tails of lead (Figure 81)

FIGURE 81



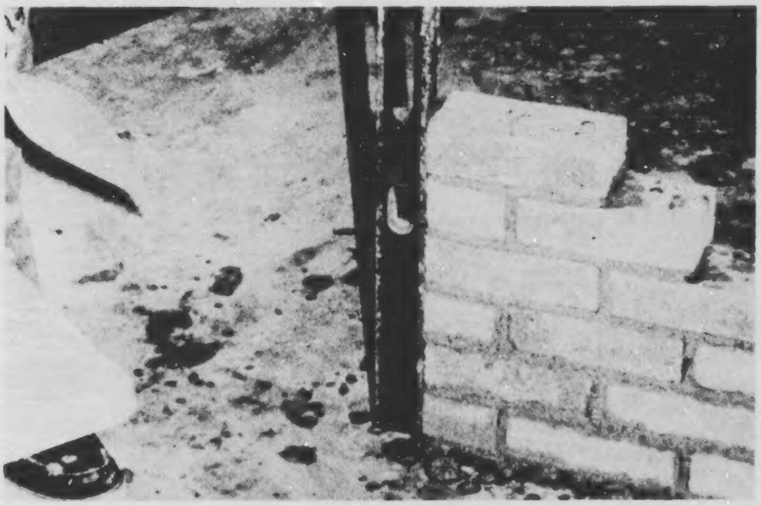
## JOB SHEET #7

S. Lay remaining three courses of lead, using same procedures used to lay first three courses

1. Keep head joints filled solid
2. Keep course level
3. Check course height with story pole
4. Make sure that corners are plumb and tails are on range (Figure 82)

   (NOTE: For the last three courses on a lead, it is a good practice to sight the corner bricks that are going to be laid with the three courses that have been plumbed.)

FIGURE 82



T. Clean work area; clean and put away all tools and equipment

# SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## TEST

NAME ______________________________ SCORE ____________

1. Match to their correct definitions terms associated with spreading mortar and laying block and brick. Write the correct numbers in the blanks. Definitions are continued on the following page.

______a. Vertical mortar joint between two units

______b. To remix mortar to proper consistency

______c. Consistency or density of mortar that is plastic and workable

______d. Perfect vertical plane

______e. Plastic or wood blocks used to hold line tight

______f. Last unit laid in a course

______g. Slight indentation made in bed joint mortar

______h. Horizontal mortar joint between two units

______i. Method of stepping back successive courses

______j. Process of placing mortar for the course to be laid

______k. To cause to conform to a specified grade; perfect horizontal plane

______l. Relative mobility, or ability of fresh mortar to flow

______m. Wooden pole upon which are marked course heights and openings

______n. Mixture of lime, sand, and water

______o. Depression, such as a groove or recess, in one or both of the larger sides of a brick or block; provides key for mortar at joints

______p. Mixture of cementitious materials, such as portland cement, lime, sand, and water

1. Line blocks
2. Level
3. Bed joint
4. Spreading mortar
5. Story pole
6. Plumb
7. Ferrule
8. Temper
9. Block or brick leads
10. Mortar
11. Closure
12. Mortar body
13. Racking back
14. Head joint
15. Deadman
16. Consistency
17. Furrow
18. Laboratory mortar
19. Frog

## TEST

______q. Metal cap around handle of brick trowel at shank end

______r. Something to which the line is attached for lead or first course

______s. Sections of wall built up and racked back on successive courses; used to attach line as guide for constructing wall between them

2. Describe the correct way to hold a brick trowel.

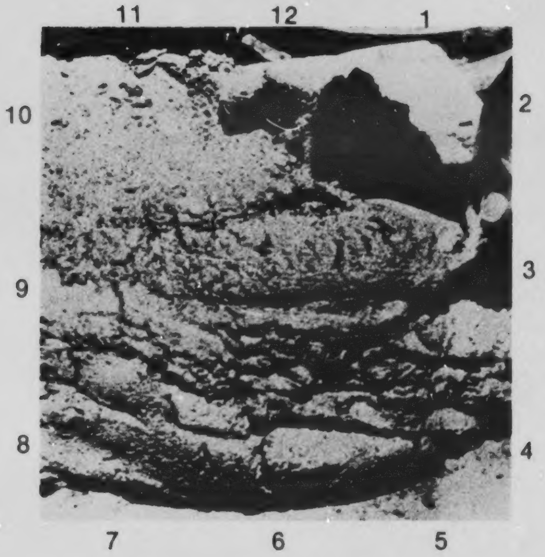
a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

3. Label methods of picking up mortar from mortarboard.



a. ______________________________

______________________________

b. ______________________________

______________________________

## TEST

4. Arrange in order procedures used to pick up mortar. Write a "1" in the blank before the first procedure, a "2" before the second procedure, and so on.

______a. Hold trowel flat against mortarboard, and slide it forward under the small pile of mortar

______b. Use a rolling motion to move the mortar to edge of mortarboard

______c. Use a downward slicing motion of trowel to separate a portion of mortar from main pile

______d. While pushing forward, lift mortar with an upward motion of trowel

______e. Use trowel to work mortar into a long, tapered shape

5. Describe why wrist is snapped when picking up mortar.

______________________________________________

______________________________________________

6. Explain direction of travel for placing mortar.

a. Right-handed person

1. ______________________________________________

2. ______________________________________________

b. Left-handed person

1. ______________________________________________

2. ______________________________________________

7. Arrange in order procedures for placing mortar. Write a "1" in the blank before the first procedure, a "2" before the second procedure, and so on.

______a. Keep elbow slightly away from body

______b. Load trowel

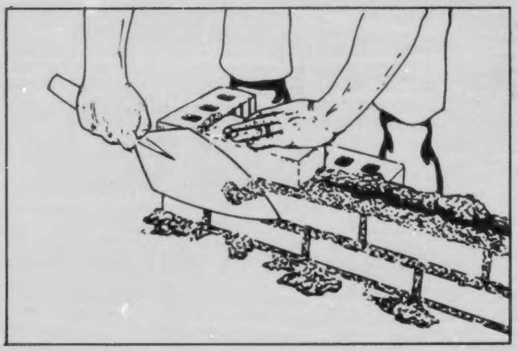
______c. Fill any spaces in bed joint with excess mortar

______d. Use a sweeping motion to spread mortar

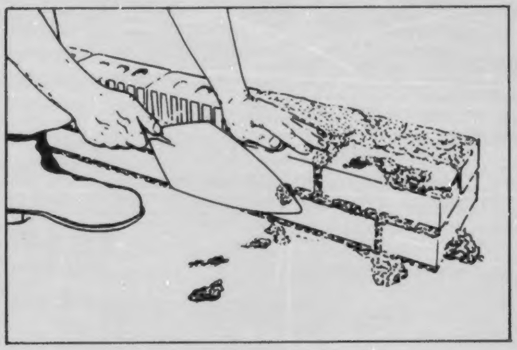
## TEST

8. Identify direction of travel for laying brick or block. Write the correct directions in the blanks.

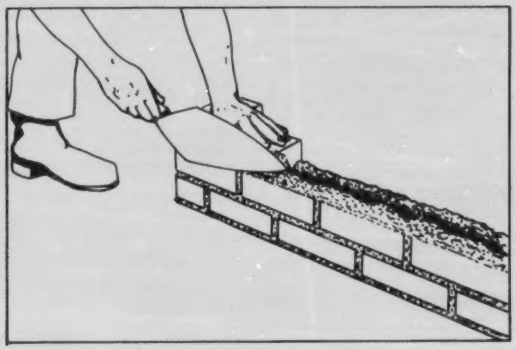
**Laying to hand** **Laying backhand or against hand** **Laying overhand**



a. ____________________



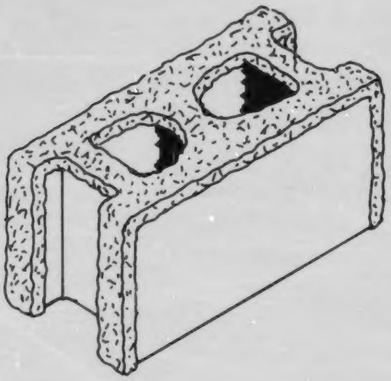
b. ____________________



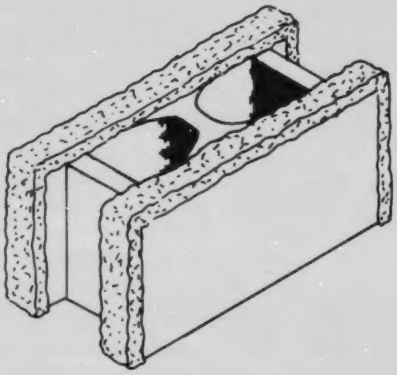
c. ____________________

## TEST

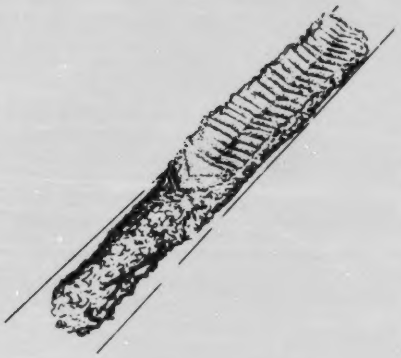
9. Label the following types of bedding.



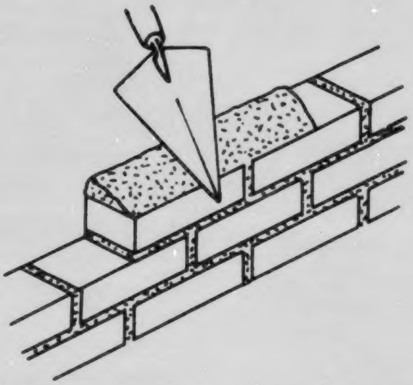
a. ______________________________



b. ______________________________



c. ______________________________



d. ______________________________

10. State two purposes of the frog.

a. ______________________________

b. ______________________________

11. Select from the following list basic skills used in masonry work. Write an "X" in the blank before each correct answer.

_____a. Striking mortar joints with brick hammer

_____b. Plumbing masonry units

_____c. Cutting masonry units with skill saw

## TEST

______d. Spreading mortar with brick trowel

______e. Checking course height with a modular rule

______f. Applying head joints to masonry

______g. Leveling masonry courses

______h. Cutting reinforcing steel with hammer and brick set

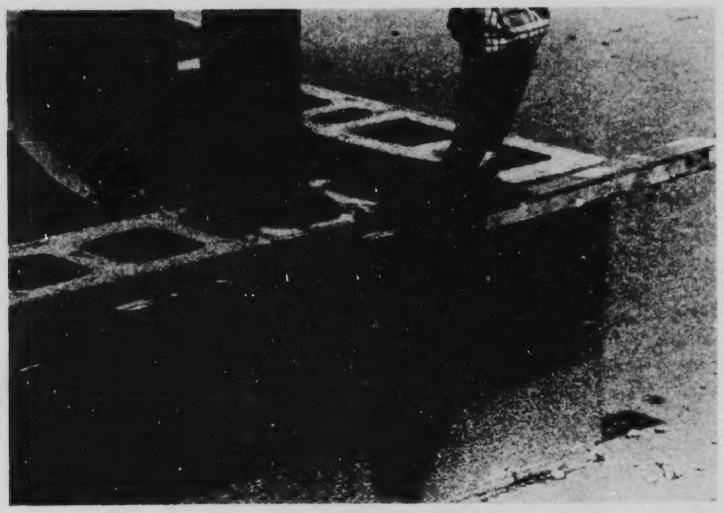
______i. Brushing wall and striking joints

______j. Checking alignment

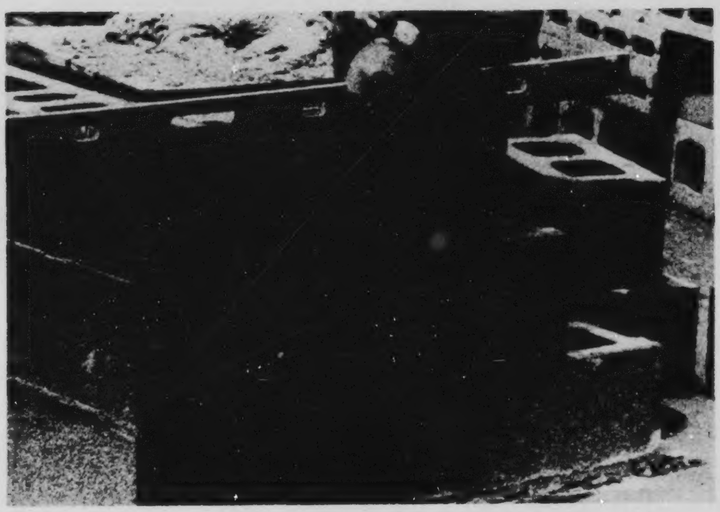
12. Label the following methods used to align masonry units.

a. ______________________________

TEST



b. ______________________________



c. ______________________________

TEST

d. ______________________________

e. ______________________________

13. State five bricklaying safety rules.

a. ______________________________

______________________________

# TEST

b. ______________________________

______________________________

c. ______________________________

______________________________

d. ______________________________

______________________________

e. ______________________________

______________________________

(NOTE: Test question 14 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

14. Demonstrate the ability to

    a. Spread mortar on a two-by-four.

    b. Swipe mortar on a two-by-four for block.

    c. Lay block to established leads.

    d. Build a 90-degree block lead.

    e. Spread mortar on a two-by-four for brick.

    f. Lay brick to established leads.

    g. Build a 90-degree brick lead.

## SPREADING MORTAR AND LAYING BLOCK AND BRICK
## UNIT II

## ANSWERS TO TEST

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. | a. | 14 | f. | 11 | k. | 2 | p. | 10 |
| | b. | 8 | g. | 17 | l. | 16 | q. | 7 |
| | c. | 12 | h. | 3 | m. | 5 | r. | 15 |
| | d. | 6 | i. | 13 | n. | 18 | s. | 9 |
| | e. | 1 | j. | 4 | o. | 19 | | |

2. Description should include the following
    a. Place fingers at bottom of handle
    b. Place thumb on top of ferrule, pointing toward point of blade
    c. Hold handle firmly, but with a relaxed grip
    d. Apply pressure between thumb and forefinger

3. a. Clock method (from the middle of mortarboard)
    b. Cupping method (from the side of mortarboard)

| | | | | |
|---|---|---|---|---|
| 4. | a. | 4 | d. | 5 |
| | b. | 2 | e. | 3 |
| | c. | 1 | | |

5. Description should include the following — To set mortar on the trowel to keep it from falling off

6. Answer should include the following
    a. Right-handed person
        1. Spreads left to right
        2. Moves backwards

## ANSWERS TO TEST

b. Left-handed person

1. Spreads right to left

2. Moves backwards

7. a. 2 c. 4

b. 1 d. 3

8. a. Laying overhand

b. Laying backhand or against hand

c. Laying to hand

9. a. Full mortar

b. Face shell

c. Furrowed

d. Tapered or beveled

10. Answer should include any two of the following

a. Locks mortar into recess for better grip

b. Creates special effects when bricks are laid on their sides

c. Saves cost of material

11. b, d, e, f, g, i, j

12. a. Checking course height

b. Checking alignment (in-line)

c. Leveling

d. Plumbing

e. Racking or tailing a lead

## ANSWERS TO TEST

13. Answer should include any five of the following
    a. Always cut masonry away from other workers
    b. Wear proper protective clothing and safety equipment when using masonry saw
    c. Always replace mortar carefully on mortarboard or in tub; never throw it so that it will splash
    d. Keep tools out of path of other people
    e. Always hand tools or materials to other person; never throw them
    f. Use proper tool for job, and practice good tool habits as skills are learned
    g. Lift heavy objects properly
    h. Follow OSHA regulations

14. Performance skills evaluated to the satisfaction of the instructor

# CHIMNEYS AND FIREPLACES
## UNIT III

## UNIT OBJECTIVE

After completing this unit, the student should be able to lay up a chimney, firebox, and fireplace. The student will show this knowledge by completing the job sheets and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with chimneys and fireplaces to their correct definitions.
2. Explain the function of a chimney.
3. Identify the parts of a chimney.
4. State factors to consider in design of chimneys.
5. Label types of fireplaces.
6. Identify the parts of a fireplace.
7. State factors to consider when constructing chimneys and fireplaces.
8. Arrange in order the procedures for applying fireclay to firebrick.
9. Distinguish between firebrick clay mortar and brick mortar.
10. State characteristics of firebrick.
11. State characteristics of a firebox.
12. Label types of hoods.
13. Demonstrate ability to
    a. Cut hole in flue liner.
    b. Install lining and lay up chimney.
    c. Construct a firebox.
    d. Construct a fireplace.

# CHIMNEYS AND FIREPLACES
## UNIT III

## SUGGESTED ACTIVITIES

I. Suggested activities

   A. Lay bottom part of chimney as illustrated in Figure 17 so that students may complete Job Sheet #2.

   B. Obtain transparencies.

   (NOTE: Transparencies are available from AGC and CIMC.)

   C. Provide students with objective sheet.

   D. Discuss unit and specific objectives.

   E. Provide students with information and job sheets.

   F. Discuss information sheet.

   G. Gather equipment and materials for job sheet demonstrations.

   H. Demonstrate and discuss procedures outlined in job sheets.

   I. It is recommended that the instructor introduce fireplace building only to students who have advanced experience.

   J. Give test.

   K. Complete appropriate section of competency profiles.

   (NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM #1 — Parts of a Chimney

      2. TM #2 — Parts of a Fireplace

   E. Job sheets

      1. Job Sheet #1 — Cut Hole in Flue Liner

      2. Job Sheet #2 — Install Lining and Lay Up Chimney

## SUGGESTED ACTIVITIES

3. Job Sheet #3 — Construct a Firebox

4. Job Sheet #4 — Construct a Fireplace

F. Test

G. Answers to test

III. Unit references

A. Graham, Frank D. *Audel's Masons and Builders Guide,* Vol. I. Indianapolis, Indiana: Theodore Audel and Co./Howard W. Sams and Co., Inc., 1967.

B. Kreh, R. T., Sr. *Masonry Skills.* Albany, New York: Delmar Publishers, Inc., 1982.

C. Ray, J. Edgar. *The Art of Bricklaying,* 3rd ed. Revised by Harold V. Johnson. Peoria, Illinois: Chas. A. Bennett Co., 1971.

D. Roark, William F., and Harry C. Plummer. *Bricklaying Vocational Training.* McLean, Virginia: Brick Institute of America, 1973.

E. Taylor, Merlin, and Harland Randolph. *The Bricklayer,* Vol. 3, *Brick and Block Construction.* Washington, D.C.: International Masonry Apprenticeship Trust, 1977.

F. Turcotte, Raymond J. *Bricklaying Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1977.

# CHIMNEYS AND FIREPLACES
## UNIT III

## INFORMATION SHEET

I. Terms and definitions

  A. Ash dump — Metal door set in floor of firebox or combustion chamber; allows ashes to be dumped into ashpit

  B. Breast — That part of fireplace above jambs and opening

  C. Cap — Sloped, reinforced concrete or stone at top of chimney; designed to drain water away

  D. Cleanout — Access at base of chimney for cleaning out ashes

  E. Corbeled support — Projection of masonry unit that forms a ledge or shelf

  F. Damper — Metal frame with adjustable door that sits on top of firebrick of combustion chamber

  G. Downdraft — Gusts of wind deflected down chimney

  H. Draft — Movement of flue gases or air through chimney

  I. Fire stop — Projection of brickwork on walls between joists; designed to prevent spread of fire

  J. Flashing — Material placed around chimney at roof level to prevent water penetration and provide water drainage

  K. Flue — Air channel in chimney that conveys smoke and gases to outer air

  L. Mantel — Shelf projecting beyond face of fireplace

  M. Parging — Applying a thin coat of mortar to masonry

  N. Radiation — Transmission of heat through space by wave motion

  O. Spark arrester — Metal screen covering top of chimney; designed to prevent sparks from coming out of chimney

  P. Smoke chamber — Space in fireplace directly above throat where smoke gathers before passing into flue; narrowed by cutting brick and parging to size of flue lining above

  Q. Smoke shelf — Shelf directly behind damper throat; prevents downdraft

## INFORMATION SHEET

- R. Thimble — Metal, terra-cotta, or fired clay insert that fits into chimney to receive furnace pipe; forms a fireproof connection through masonry wall

- S. Throat — Opening at top of fireplace through which smoke passes to smoke chamber and chimney

II. Function of a chimney — To produce draft necessary to carry smoke and gases to outside of structure without endangering structure or its occupants

III. Parts of a chimney (Transparency #1)

- A. Footing
- B. Cleanout
- C. Ashpit or open chamber
- D. Header
- E. Flue lining
- F. Thimble
- G. Cap or wash
- H. Flashing
- I. Hood
- J. Spark arrester

IV. Factors to consider in the design of chimneys

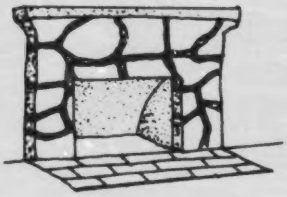
- A. Draft requirements
- B. Height
- C. Anticipated wind, earthquake, or blast loads
- D. Weight of chimney
- E. Stability and allowable bearing pressure of soil
- F. Expansion and contraction of chimney walls due to temperature changes of gases in flue

## INFORMATION SHEET

V. Types of fireplaces (Figures 1-10)

A. Single face

FIGURE 1



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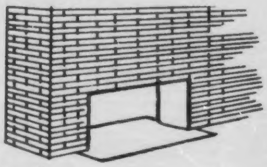
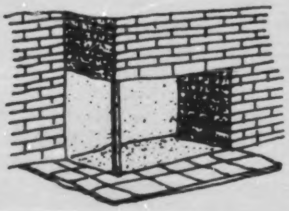
B. Two faces (opposite)

FIGURE 2



C. Two faces (adjacent)

FIGURE 3



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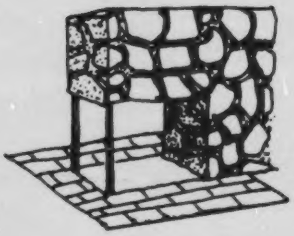
## INFORMATION SHEET

D. Three faces

FIGURE 4



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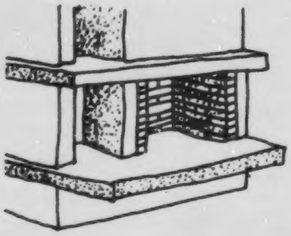
E. Cantilevered hearth

FIGURE 5



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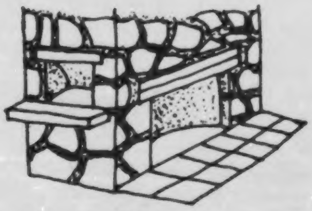
F. Combination unit

FIGURE 6



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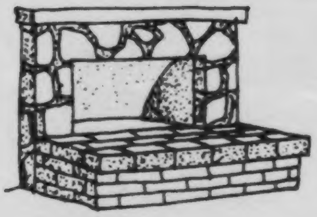
## INFORMATION SHEET

### G. Raised hearth

FIGURE 7



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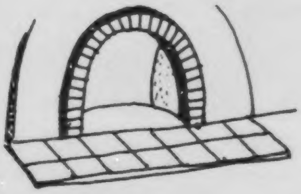
### H. Arched lintel

FIGURE 8



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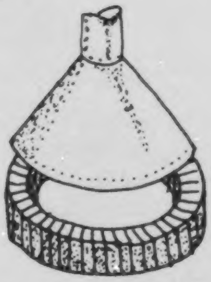
### I. Firepit with hood

FIGURE 9



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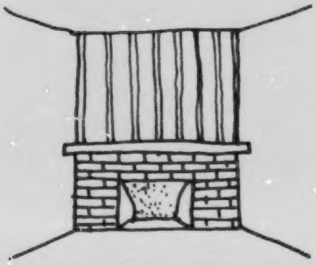
## INFORMATION SHEET

J. Corner unit

FIGURE 10



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VI. Parts of a fireplace (Transparency #2)

A. Cleanout

B. Ashpit

C. Reinforced brick slab

D. Ash dump

E. Brick outer hearth

F. Firebrick

G. Damper

H. Breast

I. Smoke shelf

J. Throat

K. Mantel

L. Smoke chamber

M. Flue lining

N. Fire stop

O. Flashing

P. Cap

## INFORMATION SHEET

Q. Spark arrester

VII. Factors to consider when constructing chimneys and fireplaces

A. Footing should be sufficient to support chimney and fireplace

B. Fireplace should be laid out at its specified location maintaining lateral and vertical clearances

C. Masonry below fireplace should be same perimeter as fireplace

D. Size of specified damper should be same as finished fireplace opening

E. Finished opening height should be less than width of finished opening of fireplace

F. Bottom of damper should be 6 to 8 inches above top of finished opening

G. Smoke shelf should be kept level with bottom of damper

H. Damper should be measured at bottom of inside for fireplace opening and sides of firebox

I. Chimney should be 3 feet above highest point of roof where it passes through roof, and at least 2 feet higher than any portion of building that is within 10 feet of it

(NOTE: Distance and dimension will vary according to building code.)

VIII. Procedures for applying fireclay to firebrick

A. Mix fireclay to a consistency of heavy whipped cream

B. Pick up dry brick

(NOTE: Do not wet firebrick.)

C. Apply fireclay to firebrick

D. Spread fireclay evenly over all bonding surfaces

(NOTE: Joints for firebrick should be very tight, $^{3}/_{16}$ inch or less.)

IX. Firebrick clay mortar and brick mortar

A. Firebrick clay mortar

1. Withstands intensive heat

## INFORMATION SHEET

2. Is very plastic
3. Does not require sand
4. Requires water
5. Cannot be used on exterior

B. Brick mortar

1. Is used for bonding brick and block
2. Contains cement, lime, sand, and water
3. Can be used on interior or exterior
4. Resists rain after hardening

X. Characteristics of firebrick

A. Larger in size than regular brick

B. Resistant to high temperatures

C. Sensitive to moisture and cold

XI. Characteristics of a firebox

A. Slope of back throws flame forward and leads gases through throat with increasing velocity

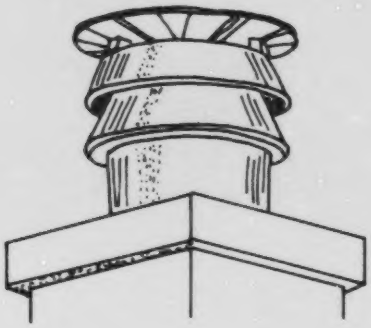
B. Angle of sides gives maximum radiation of heat into room

## INFORMATION SHEET

XII. Types of hoods (Figures 11-14)

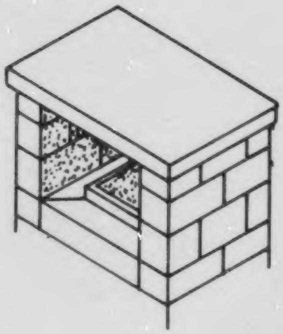
A. Metal chimney cap and hood

FIGURE 11



B. Stone hood with walls for single flue

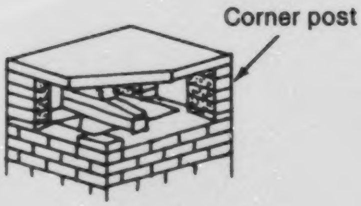
FIGURE 12



Figures 11 and 12 used with permission of the International Masonry Institute Apprenticeship and Training Program.

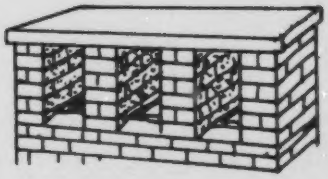
C. Stone hood with corner post for double flue

FIGURE 13



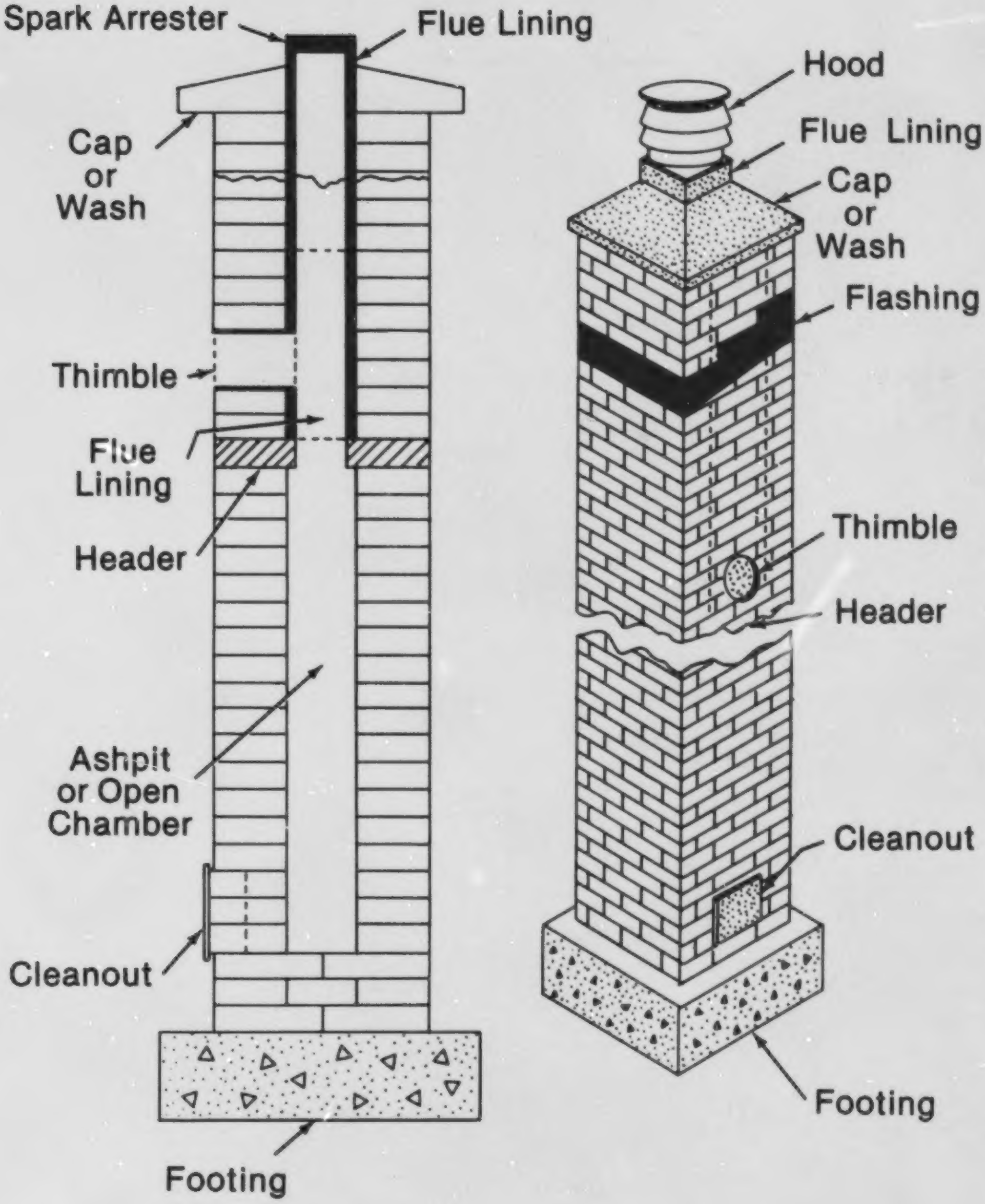
D. Stone hood with walls for triple flue

FIGURE 14



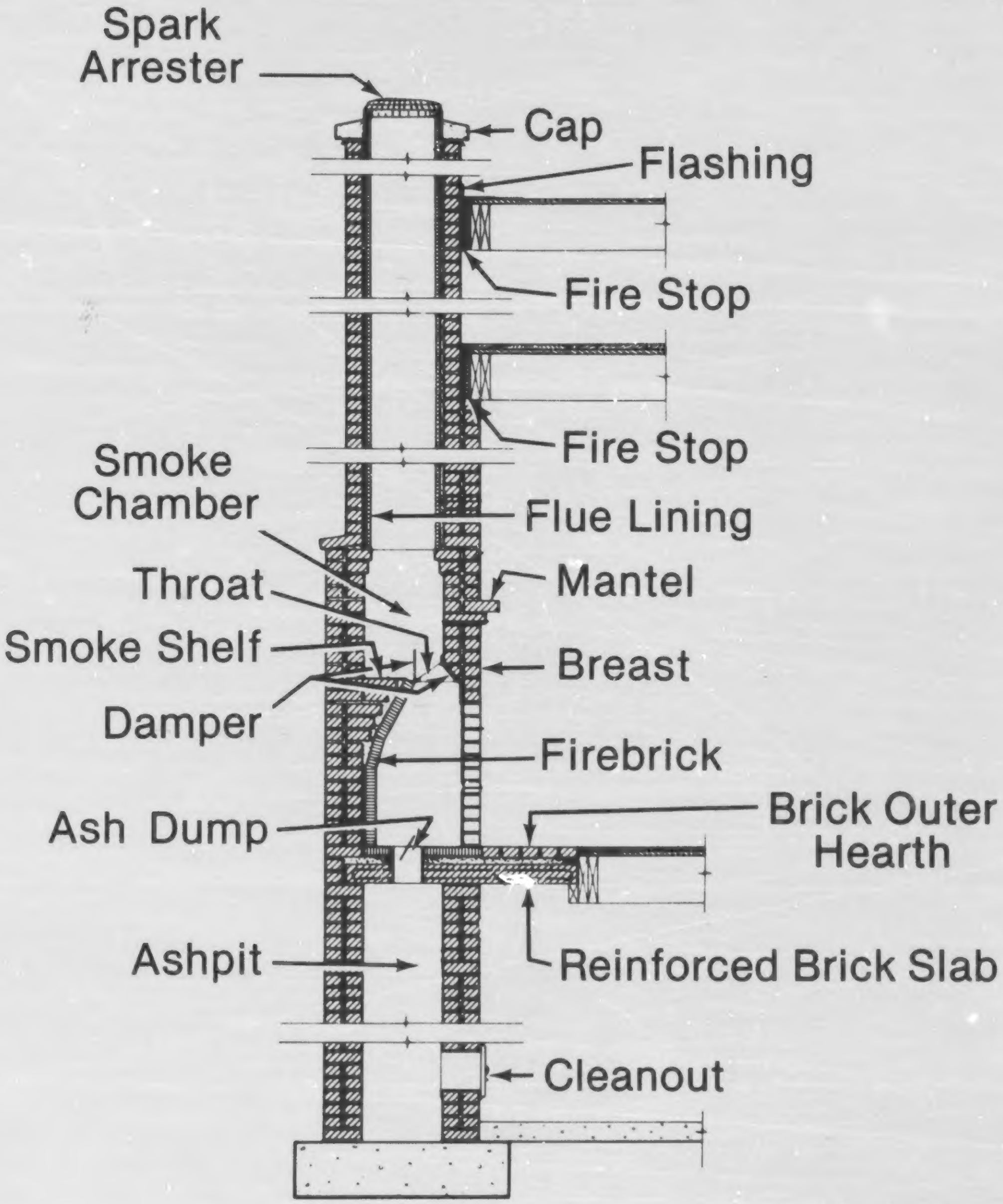
Figures 13 and 14 used with permission of the International Masonry Institute Apprenticeship and Training Program.

# Parts of a Chimney


Spark Arrester
Flue Lining
Cap or Wash
Thimble
Flue Lining
Header
Ashpit or Open Chamber
Cleanout
Footing
Hood
Flue Lining
Cap or Wash
Flashing
Thimble
Header
Cleanout
Footing

PBL - 159-C

# Parts of a Fireplace


Spark Arrester
Cap
Flashing
Fire Stop
Fire Stop
Smoke Chamber
Flue Lining
Throat
Mantel
Smoke Shelf
Breast
Damper
Firebrick
Ash Dump
Brick Outer Hearth
Ashpit
Reinforced Brick Slab
Cleanout

Section

# CHIMNEYS AND FIREPLACES
## UNIT III

## JOB SHEET #1 — CUT HOLE IN FLUE LINER

I. Equipment and materials

   A. Flue liner

   B. Shovel

   C. Chisel

   D. Hammer

   E. Light brick hammer or tile hammer

   F. Sand (enough to fill one liner)

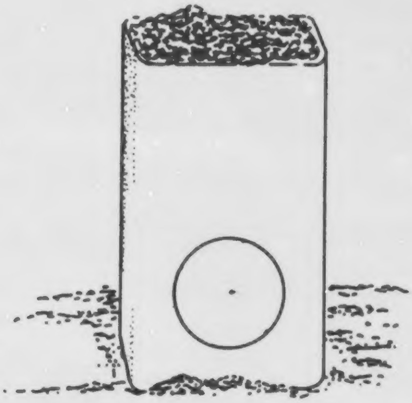
II. Procedure

   A. Select one flue liner

   B. Lay out circle for hole in correct location

   C. Set liner on level area and fill with sand (Figure 15)

FIGURE 15



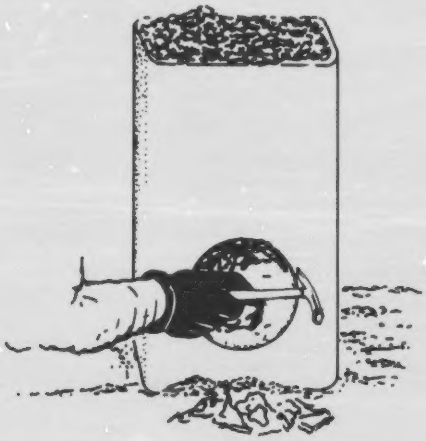
## JOB SHEET #1

D. Use chisel and hammer to cut a small hole in center of marked circle

E. Using brick hammer, work in a circular motion around center hole, cutting out pieces until opening is even with outside edge of circle

(NOTE: Use hammer very gently and cut out small sections at a time. See Figure 16.)

FIGURE 16



F. Clean and put away tools and equipment

# CHIMNEYS AND FIREPLACES
## UNIT III

## JOB SHEET #2 — INSTALL LINING AND LAY UP CHIMNEY

I. Equipment and materials

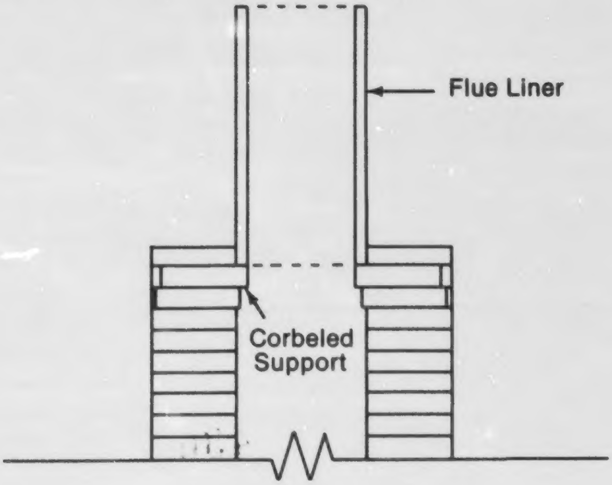
- A. Brick trowel
- B. Brick hammer
- C. Mason's level
- D. Scaffolds
- E. Flue liners
- F. Bricks
- G. Mortar
- H. Cap block
- I. Round jointer

II. Procedure

A. Set first liner inside masonry flue opening on top of the corbeled support (Figure 17)

(NOTE: The bottom of the chimney was previously laid.)

FIGURE 17



## JOB SHEET #2

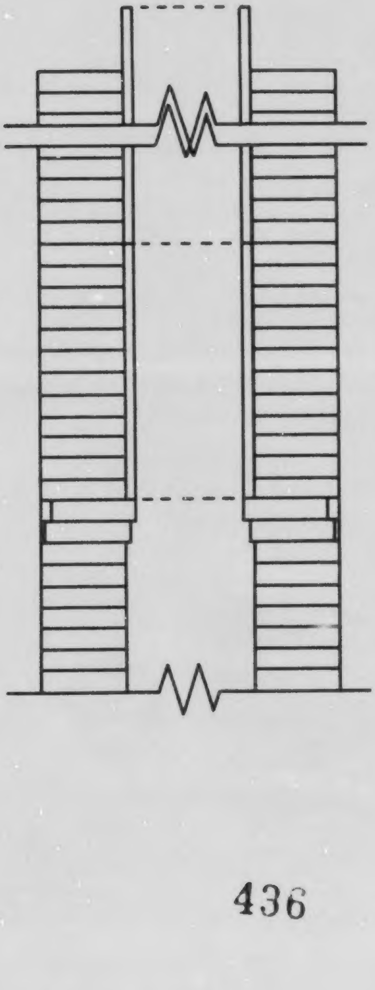
B. Lay brick around liner to its top

C. Set second liner; lay brick around second liner to its top

D. Continue setting liners and laying brick to the proper elevation, using scaffolding as necessary (Figure 18)

(NOTE: When laying chimney, be sure to maintain proper clearance where chimney goes through the ceiling and roof; also be sure to install flashing at the roof.)

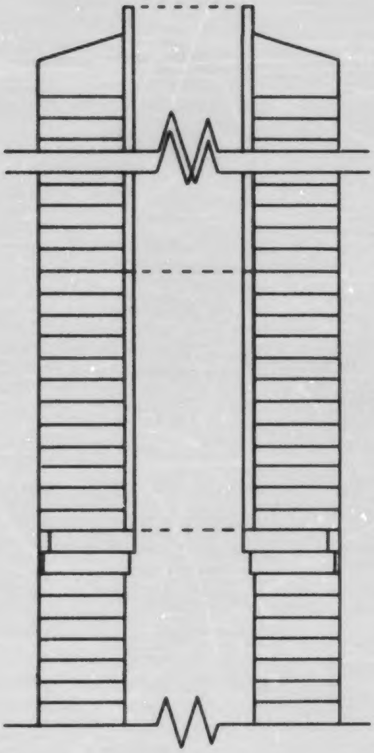
FIGURE 18



## JOB SHEET #2

E. After liners and brick are laid to the proper elevation, set the cap (Figure 19)

FIGURE 19



F. Strike joints

G. Clean and put away tools and equipment

## CHIMNEYS AND FIREPLACES
## UNIT III

### JOB SHEET #3 — CONSTRUCT A FIREBOX

I. Equipment and materials

  A. Ash dump

  B. 3-foot damper

  C. 90 firebricks

  D. Laboratory mortar

  E. Rule or tape

  F. Trowel

  G. Brick set

  H. Brick hammer

  I. Flat jointer

  J. 4-foot level

  K. Heavy-duty pencil

  L. Framing square

  M. Bevel square

  N. Soft hand brush

  O. Mortarboard

  P. Square-point shovel

  Q. 5-gallon bucket

  R. Flat wooden wheelbarrow

  S. 1 bag sand

  T. 1 bag fireclay

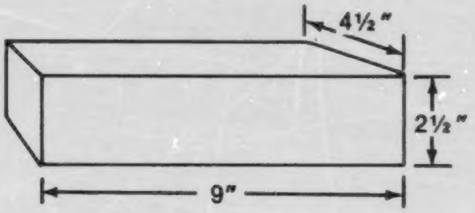
## JOB SHEET #3

II. Procedure

A. Lay out firebrick for floor of firebox (firebrick slab)

(NOTE: The firebrick should be 9 inches long, 4 1/2 inches wide, and 2 1/2 inches high. See Figure 20.)

FIGURE 20

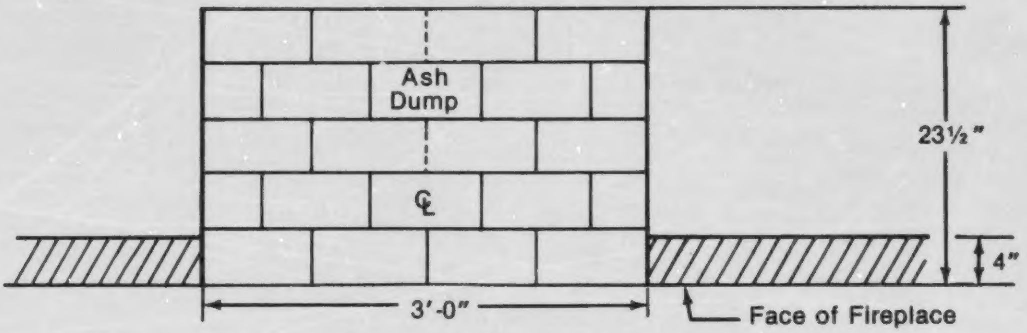


B. Lay firebrick; use fireclay for bed joint, and butter sides and end joints with fireclay

(NOTE: Make horizontal and end joints no wider than 1/4 inch.)

C. Start first course at face of fireplace and continue to a depth of about 23 1/2 inches or 5 courses laid flat (Figure 21)

FIGURE 21



D. Keep bond centered with fireplace opening

(NOTE: Keep firebox floor perfectly level. Set ash dump in center of firebox in the fourth course.)

E. Tool end and horizontal joints with flat jointer

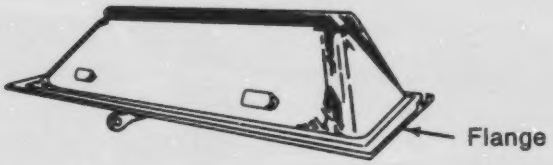
(NOTE: When all joints have been tooled, brush off floor of firebox and retool with flat jointer.)

## JOB SHEET #3

F. Place cast-iron damper flat on completed floor of firebox, with its longest length facing fireplace opening (Figure 22)

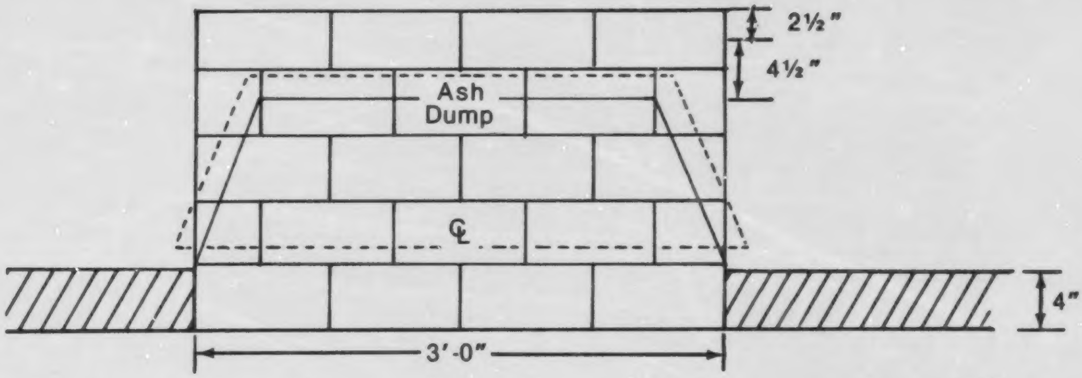
(NOTE: Handle damper with care; if dropped, it could fracture.)

FIGURE 22



G. Keep outside of damper flange 4 inches back from face of fireplace opening; center damper with fireplace opening (Figure 23)

FIGURE 23



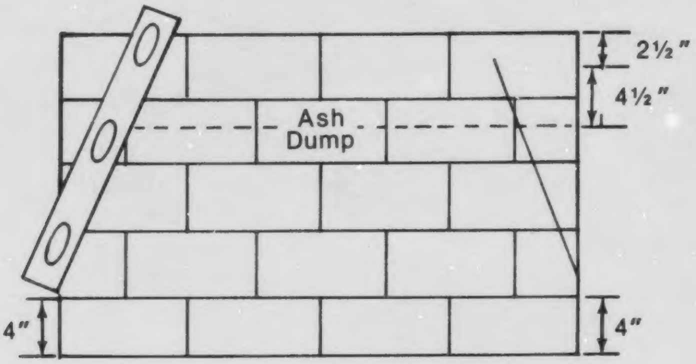
H. Mark floor of firebox along edge inside of damper on the two sides and back with a heavy-duty pencil

I. Remove damper; set aside

## JOB SHEET #3

J. Place edge of level on marks that were drawn along damper sides, and continue the lines to back of firebox on both sides to indicate sides, or splay of firebox (Figure 24)

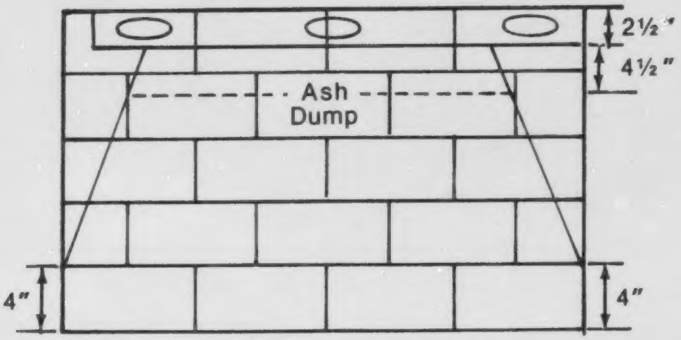
FIGURE 24



K. Measure and mark 2 ½ inches from back of firebox floor where ends of splay are marked

L. Place edge of level on the 2 ½-inch marks, and draw line with pencil (Figure 25)

FIGURE 25

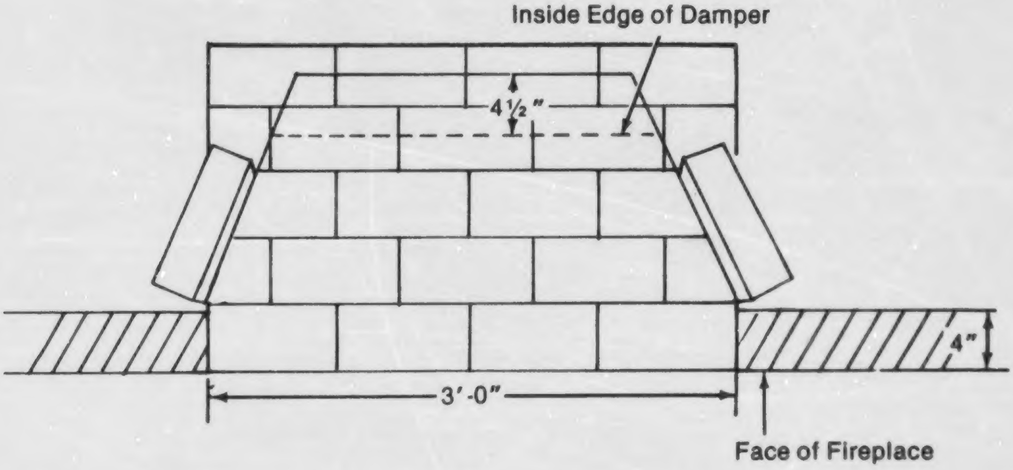


## JOB SHEET #3

M. Dry bond first course of firebrick, laying firebrick flat for firebox; start bond 4 inches back from face of fireplace opening on both sides, and keep 1/4-inch end joints

(NOTE: Make sure to stay flush with lines outlining the firebox. See Figure 26.)

FIGURE 26


Inside Edge of Damper
4 1/2"
4"
3'-0"
Face of Fireplace

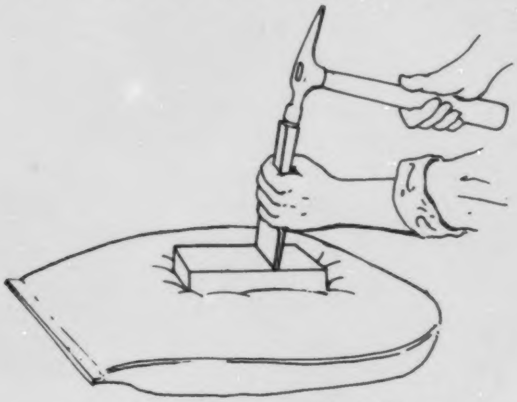
N. Fill a burlap bag with sand

## JOB SHEET #3

O. Make necessary firebrick cuts, placing bricks one at a time on sand-filled bag, and marking bricks to allow 1/4-inch end joints

(NOTE: When using a brick set, placing brick to be cut on sand-filled bag reduces the shock on the brick and makes an easier and better cut with less breakage. See Figure 27. Cuts may be made with masonry table saw if available.)

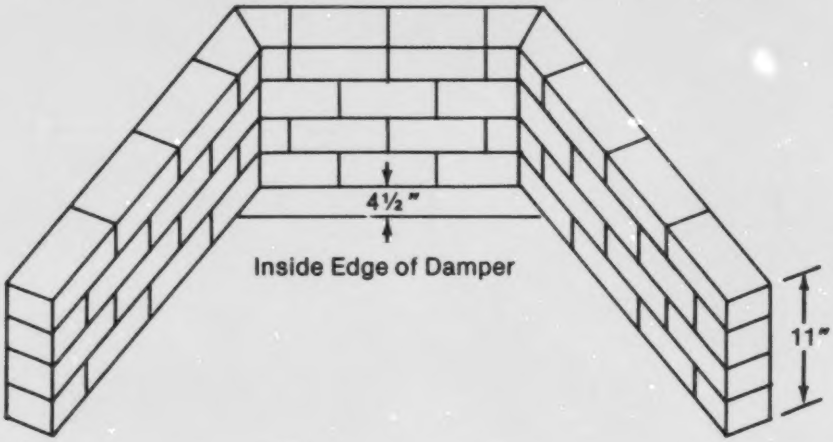
FIGURE 27



P. Lay four courses of brick at a height of 2 3/4 inches for each course, buttering ends of bricks so that end and bed joints are solid

(NOTE: Make sure to keep walls level and plumb. The height for the four courses laid should measure 11 inches from floor of firebox to top of fourth course. See Figure 28. The measurement from the inside of the damper to the back wall is 4 1/2 inches. This is how much the back wall will slope forward. Before you lay any more bricks, you have to know the angle or the slope of the back wall. The side walls when completed will be 33 inches high from floor of firebox to top of side walls or bottom of damper.)

FIGURE 28

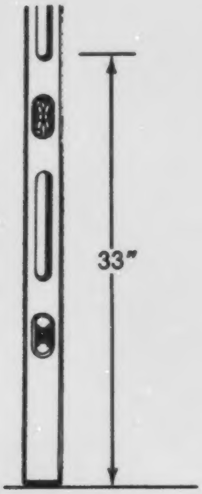


## JOB SHEET #3

Q. Determine slope of back wall

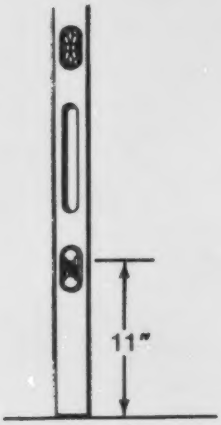
1. Place 4-foot level on wood or concrete floor and draw a line the full length of the level; measure from bottom of line and mark at 33 inches (Figure 29)

FIGURE 29



2. Measure up 11 inches from bottom mark made with level and mark again (Figure 30)

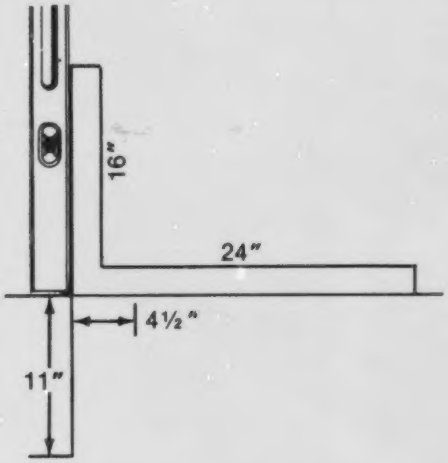
FIGURE 30



## JOB SHEET #3

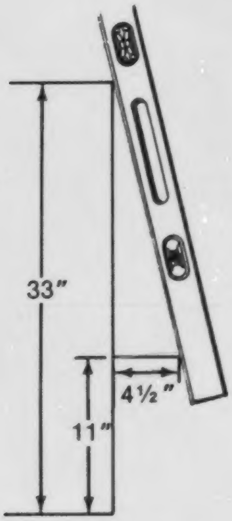
3. Square the 11-inch mark with framing square by placing square along line drawn with level and drawing a line 4 ½ inches long (Figure 31)

FIGURE 31



4. Place edge of level on end of 4 ½-inch line and on mark at 33 inches; draw line (Figure 32)

FIGURE 32

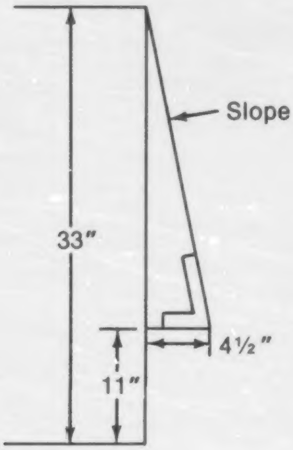


## JOB SHEET #3

5. Set bevel square on 4 ½-inch mark and adjust it to angle that was drawn from the 4 ½-inch mark to the 33-inch mark (Figure 33)

   (NOTE: This step ensures that the slant of the back wall will meet the inside of the damper at the top of the firebox.)

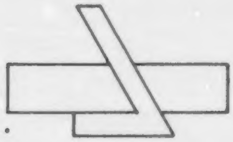
FIGURE 33



R. Lay up one side of firebox

1. Start laying firebricks from fireplace opening until you reach first firebrick that has to be cut for the back wall slope
2. Place dry firebrick, allowing an end joint of about ½ inch
3. Mark bottom of dry brick with pencil in line with inside of back wall
4. Remove brick
5. Draw cutting line on side of brick using bevel square (Figure 34)

FIGURE 34



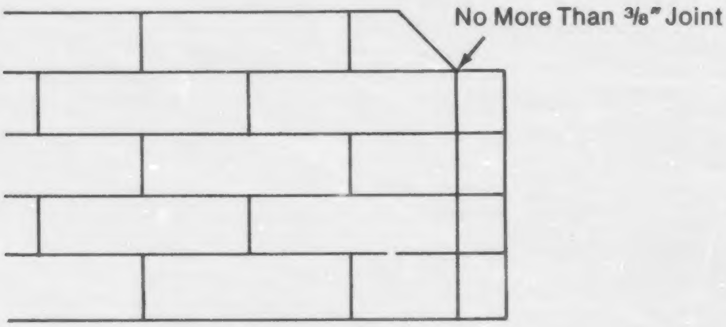
6. Place brick on sand-filled bag, and cut with brick set

   (NOTE: Cuts may be made with masonry saw if available.)

## JOB SHEET #3

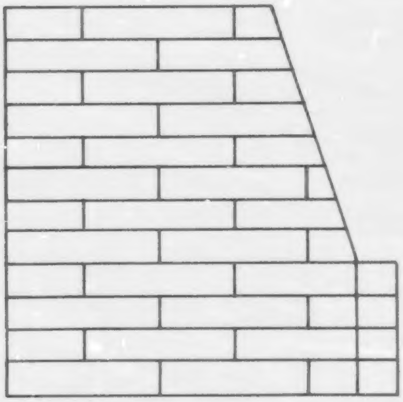
7. Lay brick, making sure that joint at bottom is 1/4 inch and no more than 3/8 inch away from back wall (Figure 35)

FIGURE 35



8. Lay the seven remaining courses of first side wall to a height of 33 inches, using the same procedures used for laying course five (Figure 36)

FIGURE 36

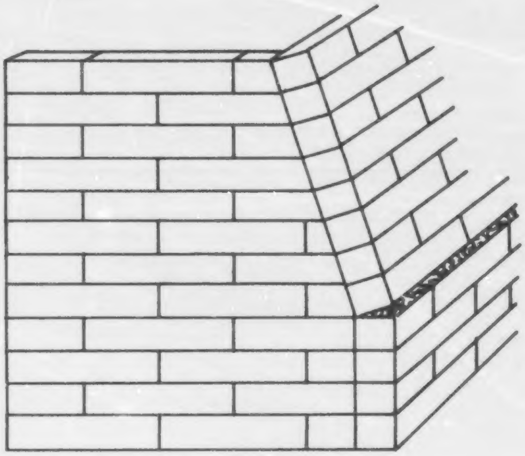


S. Lay up other side wall of firebox, using same procedures used for completed side

## JOB SHEET #3

T. Lay up the back wall to top of side walls keeping bed and end joints filled solid (Figure 37)

FIGURE 37



U. Place mortar on top course of the three sides and set damper, keeping front edge of flange even with ends of side walls

(NOTE: Tap damper gently into position with brick hammer handle so that the bed joint is tight.)

**(CAUTION: Tap damper very gently because it is made of cast iron and can be easily cracked or broken.)**

V. With trowel, cut mortar off face of bed joint on bottom edges of damper

W. Clean and put away tools and equipment

## CHIMNEYS AND FIREPLACES
## UNIT III

### JOB SHEET #4 — CONSTRUCT A FIREPLACE

I. Equipment and materials

   A. 3-foot damper

   B. Ash dump

   C. Cleanout door

   D. Angle iron, 3" × 3" × 1/4" × 3'-8"

   E. Angle iron, 3 1/2" × 3 1/2" × 1/4" × 4'-0"

   F. Flue liners, 12 " × 12"

   G. 180 firebricks

   H. 2,500 common bricks

   I. 300 face bricks for fireplace and chimney

   J. 14 bags portland cement

   K. 13 bags hydrated lime or laboratory mortar

   L. 2 cubic yards brick sand or laboratory mortar

   M. 1 bag fireclay

   N. (NOTE: In laboratory use pure lime.)

   Fireproof insulation to cover outside of damper

   O. 42 quarry tiles, 6" × 6"

   P. Assortment of #6, #8, and #10 common nails

   Q. 24 light-gauge metal ties

   R. Mortar mixer

   S. Mortar box

   T. Metal wheelbarrow

   U. Two 5-gallon buckets

   V. Round-pointed shovel

## JOB SHEET #4

W. Square-pointed shovel

X. Six 2-foot wooden horses

Y. Ten 14-foot scaffold planks

Z. Twelve 8-foot scaffold planks

AA. Six mortarboards

BB. Flat wooden wheelbarrow

CC. Two brick tongs

DD. Mortar tub

EE. Modular rule

FF. Framing square

GG. Bevel square

HH. Trowel

II. Hammer

JJ. 4-foot level

KK. Brick set

LL. Heavy-duty marking pencil

MM. Soft hand brush

NN. Plumb bob

OO. Claw hammer

PP. 50-foot water hose

QQ. Three canvases, 12′-0″ × 12′-0″

RR. Round jointer

II. Procedure

(NOTE: The procedure listed is for building a fireplace in a real situation. Instructors may make adjustments for a laboratory setting.)

A. Lay out fireplace

## JOB SHEET #4

B. Construct opening for ashpit

C. Lay out firebrick slab (Refer to Job Sheet #3)

D. Construct firebox, using a 3-foot cast-iron damper and buttering firebrick with fireclay (Refer to Job Sheet #3)

E. Complete rough part of fireplace

1. When firebox is completed and damper is set, start laying out rough part of fireplace

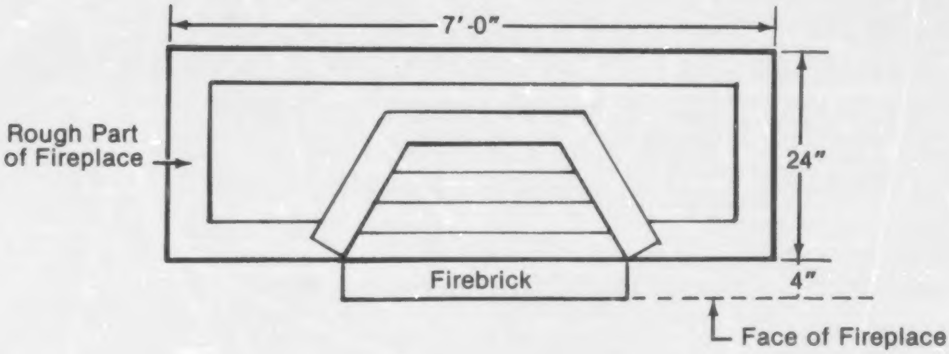
   (NOTE: It is called the rough part of the fireplace because the exterior of the back [7 feet] and the ends [24 inches] will be concealed when the house or structure is completed.)

2. Lay course of brick that is below floor

3. Lay first course of brick above floor

   (NOTE: This will lay out rough part of the fireplace. The rough part of the fireplace is kept back 4 inches from the face of the fireplace to allow enough space to build the finished face later. See Figure 38)

FIGURE 38

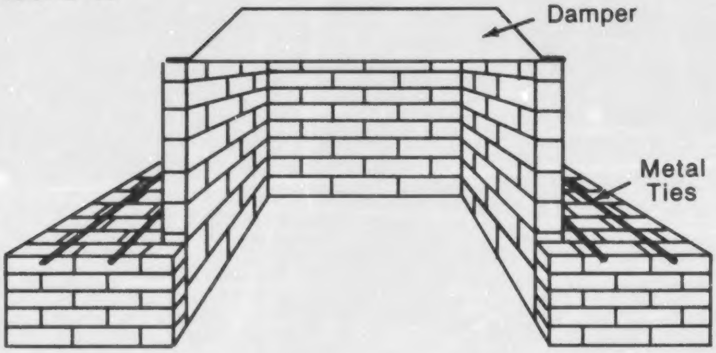


## JOB SHEET #4

4. Lay four courses, laying brick to fill spaces on sides and back of firebox; set light-gauge metal ties spaced 16 inches apart in fifth course (Figure 39)

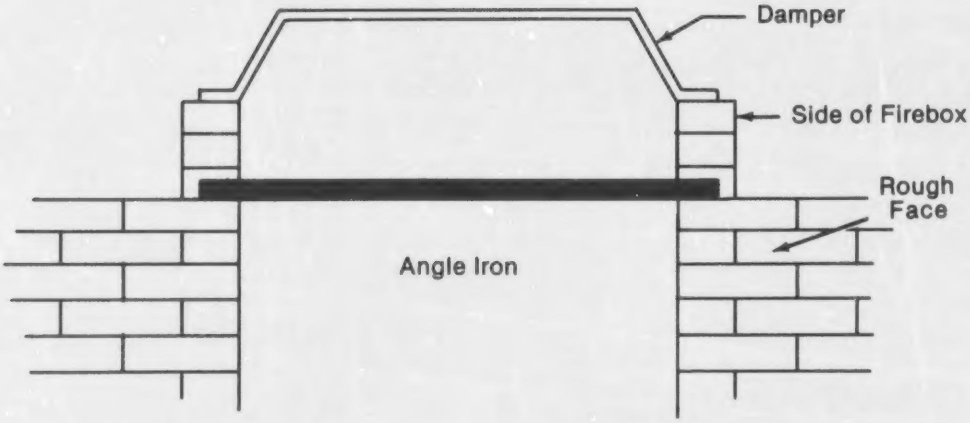
   (NOTE: Ties are placed every five courses to add strength and help bond face to rough fireplace. Spaces should be filled solid with brick to bottom of damper.)

FIGURE 39


Damper
Metal Ties

5. Lay four courses, setting 3" × 3" × ¼" × 3'-8" angle iron across front opening on ninth course (Figure 40)

FIGURE 40

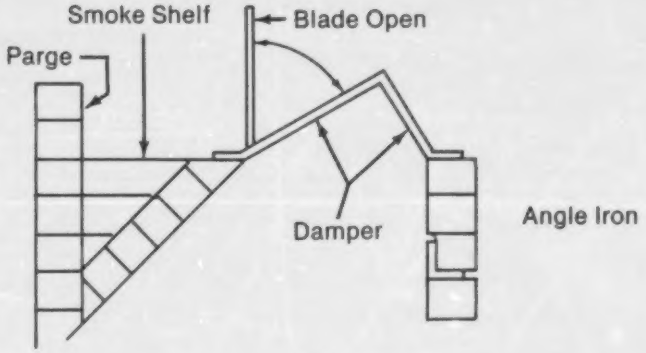

Damper
Side of Firebox
Rough Face
Angle Iron

## JOB SHEET #4

6. Lay three courses, cutting bricks to fit on angle iron; set metal ties 16 inches apart in tenth course

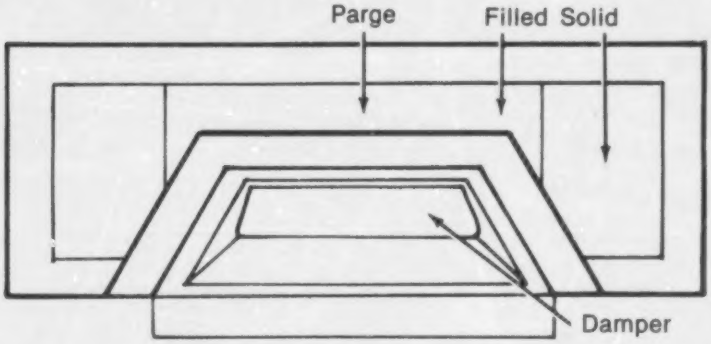
   (NOTE: This will bring masonry flush with bottom of front edge of damper. Be sure to bond bricks to damper flange. See Figure 41.)

FIGURE 41


Smoke Shelf
Blade Open
Parge
Damper
Angle Iron

7. Make smoke shelf by parging area between back of damper and inside back of fireplace (Figure 42)

FIGURE 42


Parge
Filled Solid
Damper

   (NOTE: The spaces on the sides of the firebox could be used for placing the flue linings for boiler or fireplace in basement if specified.)

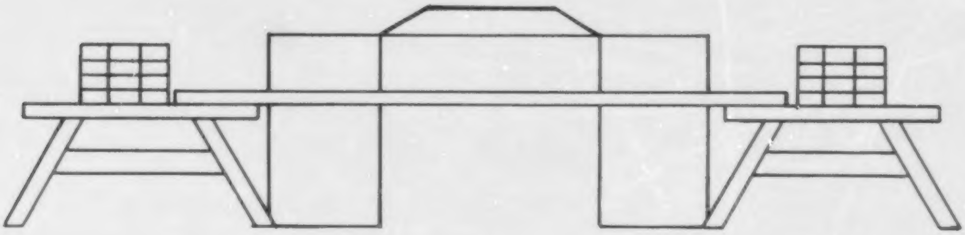
8. Place fireproof insulation at ends and back of damper

   (NOTE: This will allow for heat expansion of damper.)

## JOB SHEET #4

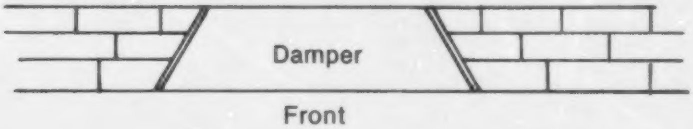
9. Build 2-foot high scaffold around fireplace for easy access and for laying out smoke chamber (Figure 43)

FIGURE 43



10. Lay brick until even with top of damper, cutting brick on slant to meet face of damper (Figure 44)

FIGURE 44

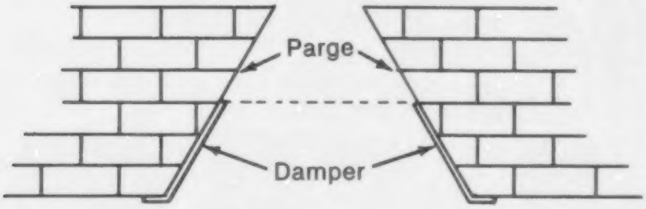


11. Lay three courses of brick on inside to form smoke chamber, cutting brick on slant to match angle of damper

(NOTE: These bricks are laid from front to back of fireplace wall.)

12. Parge interior of smoke chamber so that air and smoke will travel smoothly (Figure 45)

FIGURE 45



## JOB SHEET #4

13. Check to make sure that damper blade is clear for opening and closing before laying brick on exterior walls of rough fireplace

    (NOTE: The blade can be removed from most cast-iron dampers.)

14. Remove blade and place it away from working area so that it will not get broken

15. Use trowel to remove mortar that may have dropped on smoke shelf

16. Place a piece of heavy paper on smoke shelf

    (NOTE: A clean empty cement bag works fine.)

17. Remove paper after smoke chamber has been completed and flue lining is set in position

18. Make sure that smoke shelf and top edges of damper are cleaned

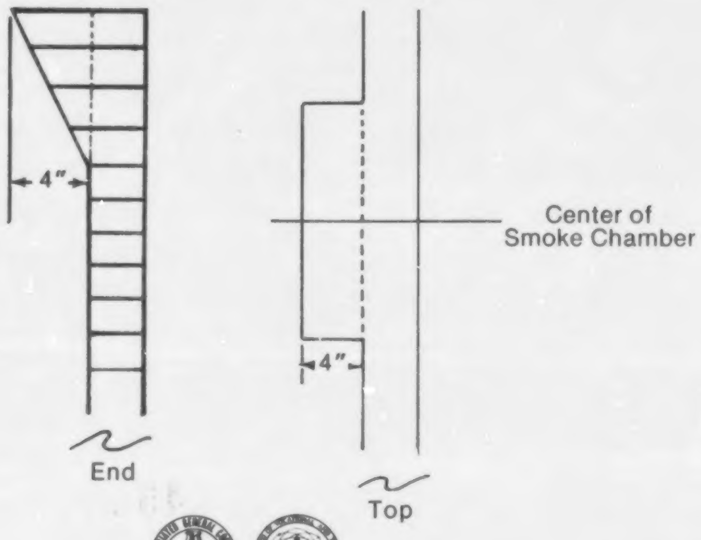
19. Replace damper blade

F. Lay brick for exterior walls

1. Lay seven courses of brick on exterior walls of rough fireplace, keeping joints filled solid

    (NOTE: When laying brick on the front wall, you will have to cut brick for slant at smoke chamber for four courses so that part of the wall will meet the inside of the flue lining. See Figure 46.)

FIGURE 46

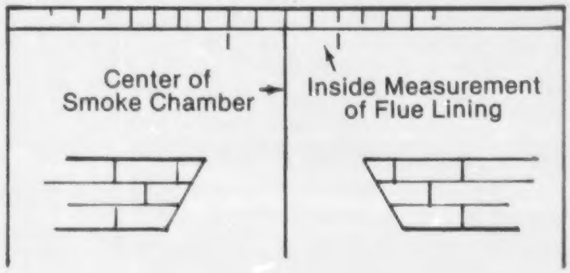


## JOB SHEET #4

2. Mark center of smoke chamber and inside measurement of flue lining (Figure 47)

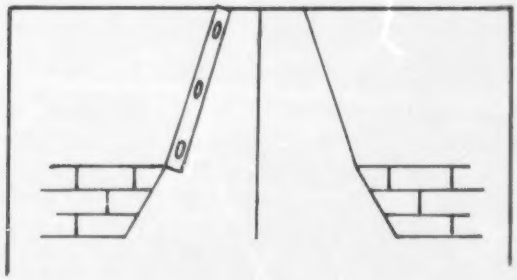
   (NOTE: Do this on both sides.)

FIGURE 47



3. Use level and draw lines from marks for inside of flue lining to part of smoke chamber that has been started (Figure 48)

FIGURE 48



4. Lay brick courses for smoke chamber, cutting brick to match lines that outline the inside of smoke chamber

   (NOTE: Be sure to keep mortar joints filled solid to prevent any possible leaks. This part of the fireplace is one of the most important. Make sure to parge the smoke chamber walls to keep them smooth and to ensure against possible leaks.)

G. Install flue lining

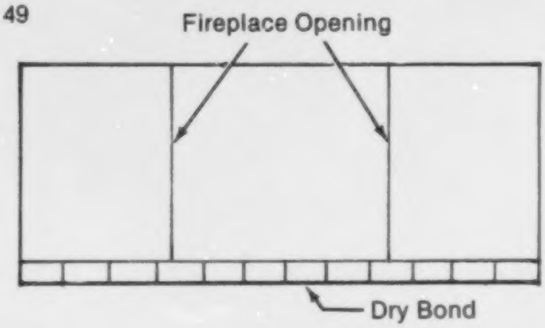
H. Build chimney

## JOB SHEET #4

I. Finish face of fireplace

1. Dry bond finished face of fireplace, making sure to lay dry bond through fireplace opening (Figure 49)

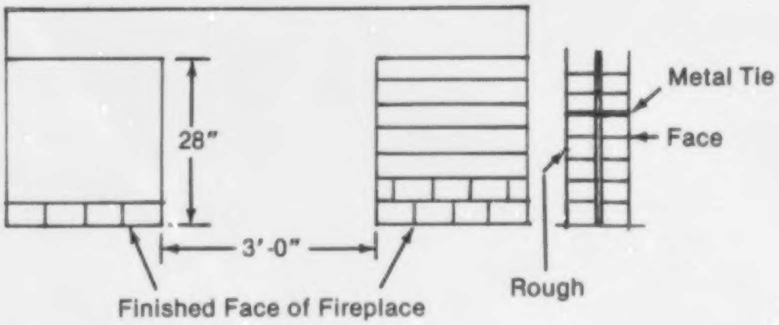
FIGURE 49


Fireplace Opening
Dry Bond

2. Lay up fireplace jambs to a height of 28 inches

(NOTE: Make sure to bond face brick to rough using the metal ties that were set in the rough part of the fireplace. Keep joint filled solid at the back of finished face. Using round jointer, tool the two jambs. See Figure 50.)

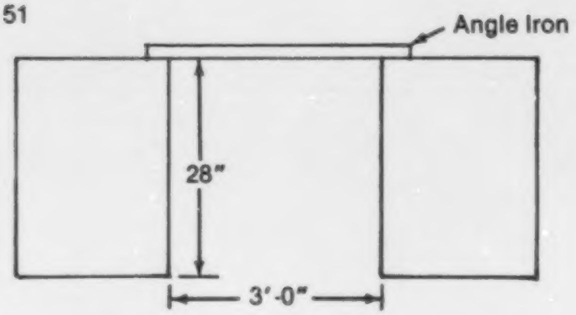
FIGURE 50


28"
3'-0"
Finished Face of Fireplace
Metal Tie
Face
Rough

## JOB SHEET #4

3. Set 3 1/2" × 3 1/2" × 1/4" × 4'-0" angle iron to cover finished opening (Figure 51)

FIGURE 51

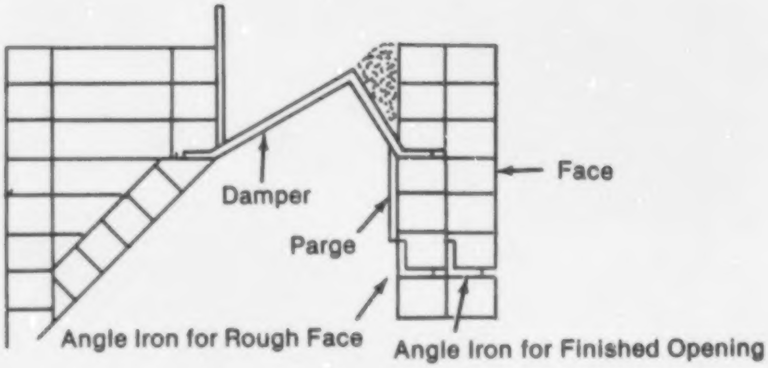

Angle Iron
28"
3'-0"

4. Continue to lay up remainder of finished fireplace face

5. Parge back of face from top of angle iron to underside of damper (Figure 52)

   (NOTE: Fill space between damper and back of face with pieces of brick and mortar, keeping pieces tight to the underside of angle.)

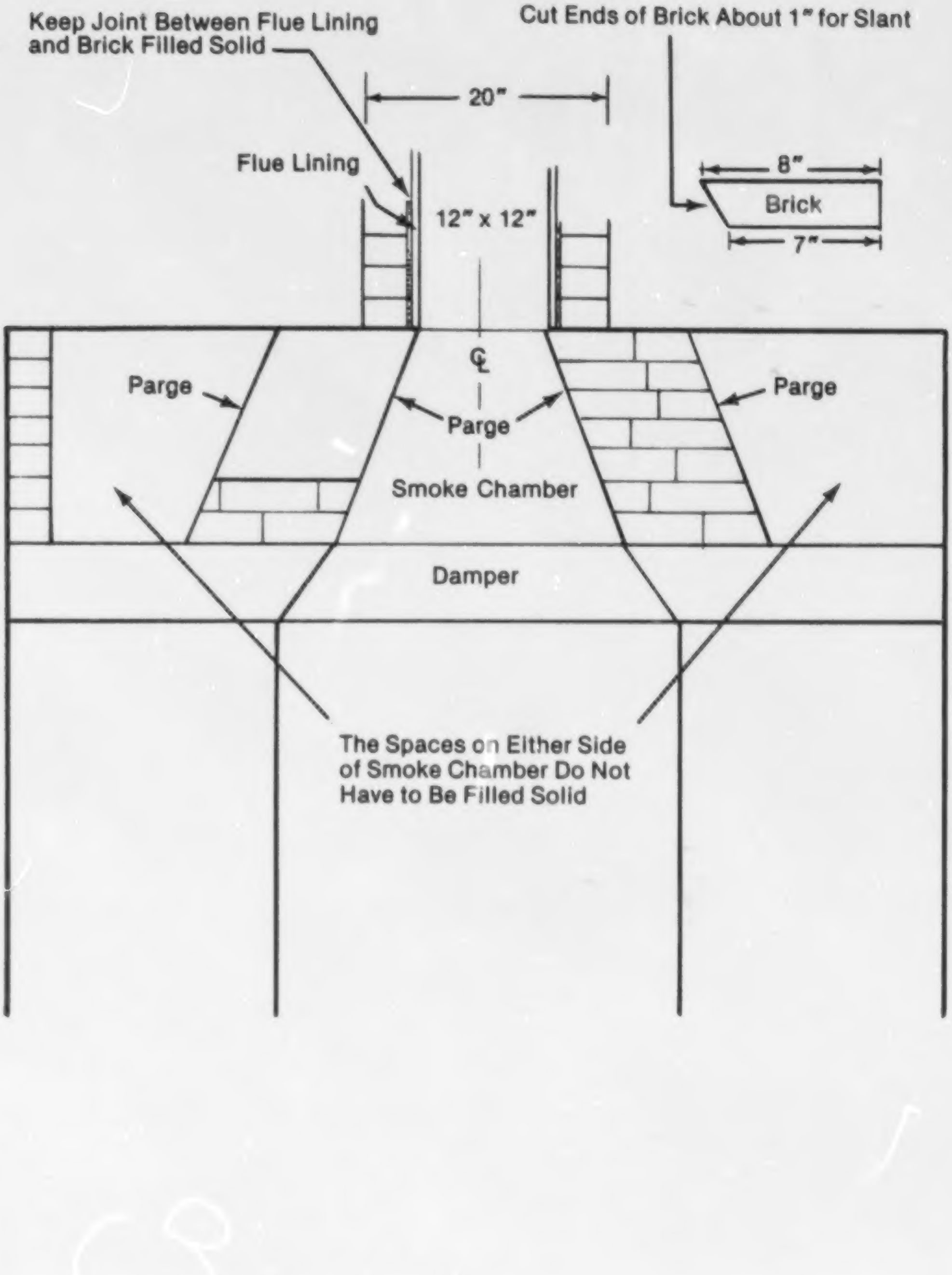
FIGURE 52


Face
Damper
Parge
Angle Iron for Rough Face
Angle Iron for Finished Opening

6. Recheck work to be sure that fireplace is completed (See Figures 53 and 54)

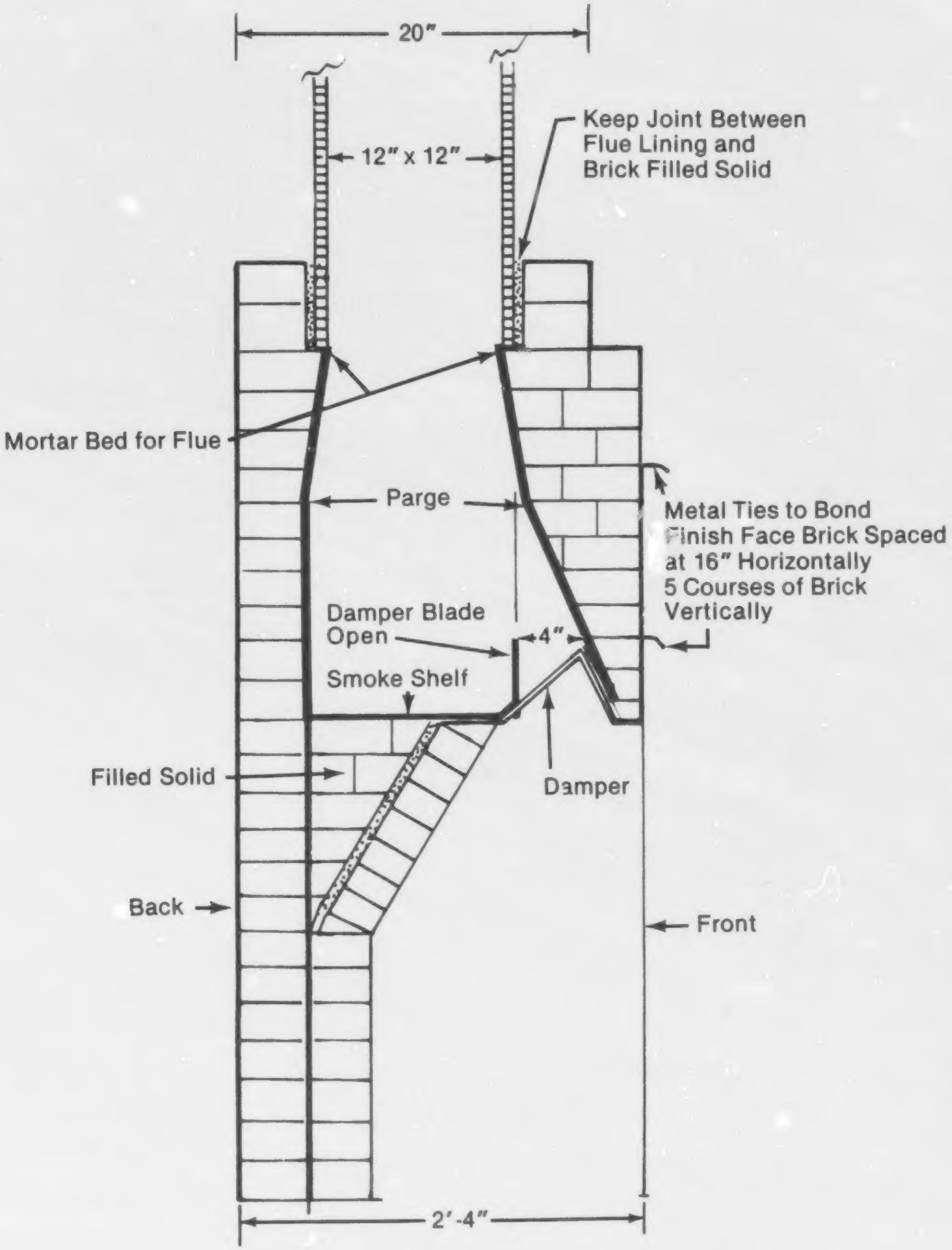
JOB SHEET #4

FIGURE 53 Completed Front Evaluation


Keep Joint Between Flue Lining and Brick Filled Solid
Cut Ends of Brick About 1" for Slant
20"
Flue Lining
12" x 12"
8"
Brick
7"
℄
Parge
Parge
Parge
Parge
Smoke Chamber
Damper
The Spaces on Either Side of Smoke Chamber Do Not Have to Be Filled Solid

JOB SHEET #4

FIGURE 54 Completed End View (Through Center of Smoke Chamber)


20"
12" x 12"
Keep Joint Between Flue Lining and Brick Filled Solid
Mortar Bed for Flue
Parge
Metal Ties to Bond Finish Face Brick Spaced at 16" Horizontally 5 Courses of Brick Vertically
Damper Blade Open
4"
Smoke Shelf
Filled Solid
Damper
Back
Front
2'-4"

## CHIMNEYS AND FIREPLACES
## UNIT III

## TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with chimneys and fireplaces to their correct definitions. Write the correct numbers in the blanks. Terms and definitions are continued on the following page.

_____a. Transmission of heat through space by wave motion

_____b. Appling a thin coat of mortar to masonry

_____c. Access at base of chimney for cleaning out ashes

_____d. That part of fireplace above jambs and opening

_____e. Projection of masonry unit that forms a ledge or shelf

_____f. Movement of flue gases or air through chimney

_____g. Shelf directly behind damper throat; prevents downdraft

_____h. Shelf projecting beyond face of fireplace

_____i. Sloped, reinforced concrete or stone at top of chimney; designed to drain water away

_____j. Air channel in chimney that conveys smoke and gases to outer air

_____k. Gusts of wind deflected down chimney

_____l. Projection of brickwork on walls between joists; designed to prevent spread of fire

_____m. Opening at top of fireplace through which smoke passes to smoke chamber and chimney

_____n. Metal frame with adjustable door that sits on top of firebrick of combustion chamber

1. Breast
2. Downdraft
3. Flue
4. Smoke shelf
5. Cap
6. Damper
7. Cleanout
8. Draft
9. Fire stop
10. Parging
11. Mantel
12. Radiation
13. Throat
14. Corbeled support

## TEST

_____o. Material placed around chimney at roof level to prevent water penetration and provide water drainage

_____p. Metal screen covering top of chimney; designed to prevent sparks from coming out of chimney

_____q. Metal door set in floor of firebox or combustion chamber; allows ashes to be dumped into ashpit

_____r. Space in fireplace directly above throat where smoke gathers before passing into flue; narrowed by cutting brick and parging to size of flue lining above

_____s. Metal, terra-cotta, or fired clay insert that fits into chimney to receive furnace pipe; forms fireproof connection through masonry wall

15. Ash dump
16. Flashing
17. Smoke chamber
18. Spark arrester
19. Thimble

2. Explain the function of a chimney.

______________________________________________

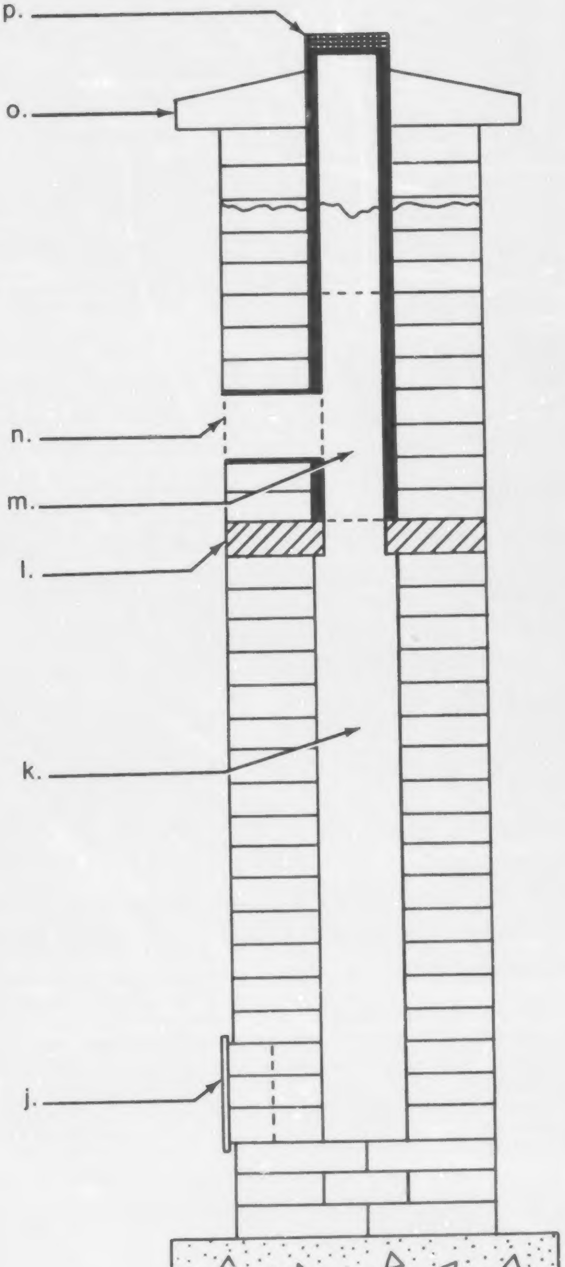
______________________________________________

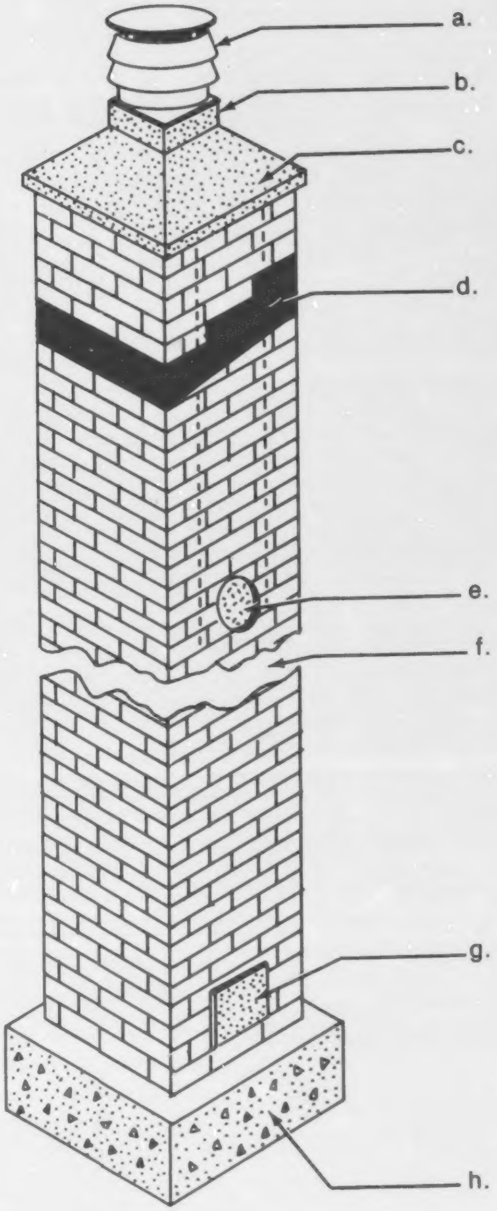
______________________________________________

3. Identify the parts of the chimney on the following page. Write the correct names in the blanks. Answers may be used more than once.

**Spark arrester**
**Ashpit or open chamber**
**Header**
**Hood**
**Flashing**
**Footing**
**Cap or wash**
**Thimble**
**Flue lining**
**Cleanout**

# TEST





## TEST

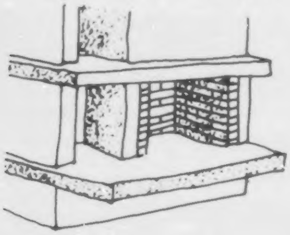
4. State three factors to consider in the design of chimneys.

a. ______________________________

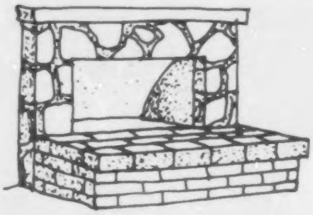
b. ______________________________

c. ______________________________

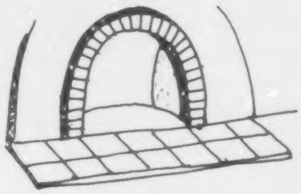
5. Label the following types of fireplaces.



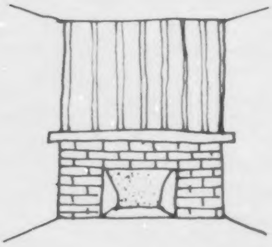
a. ____________________



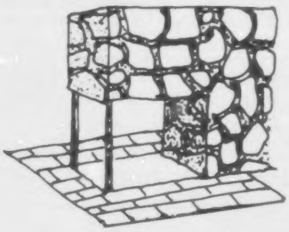
b. ____________________



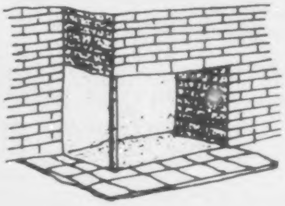
c. ____________________



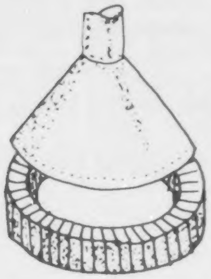
d. ____________________



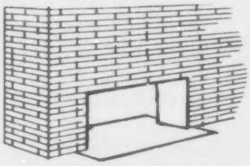
e. ____________________



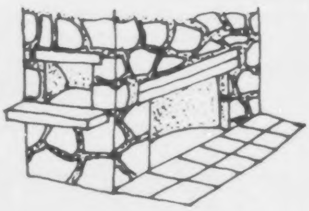
f. ____________________



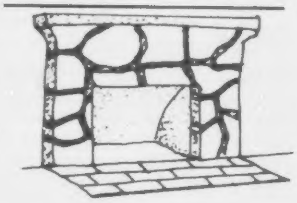
g. ________________



h. ________________



i. ________________

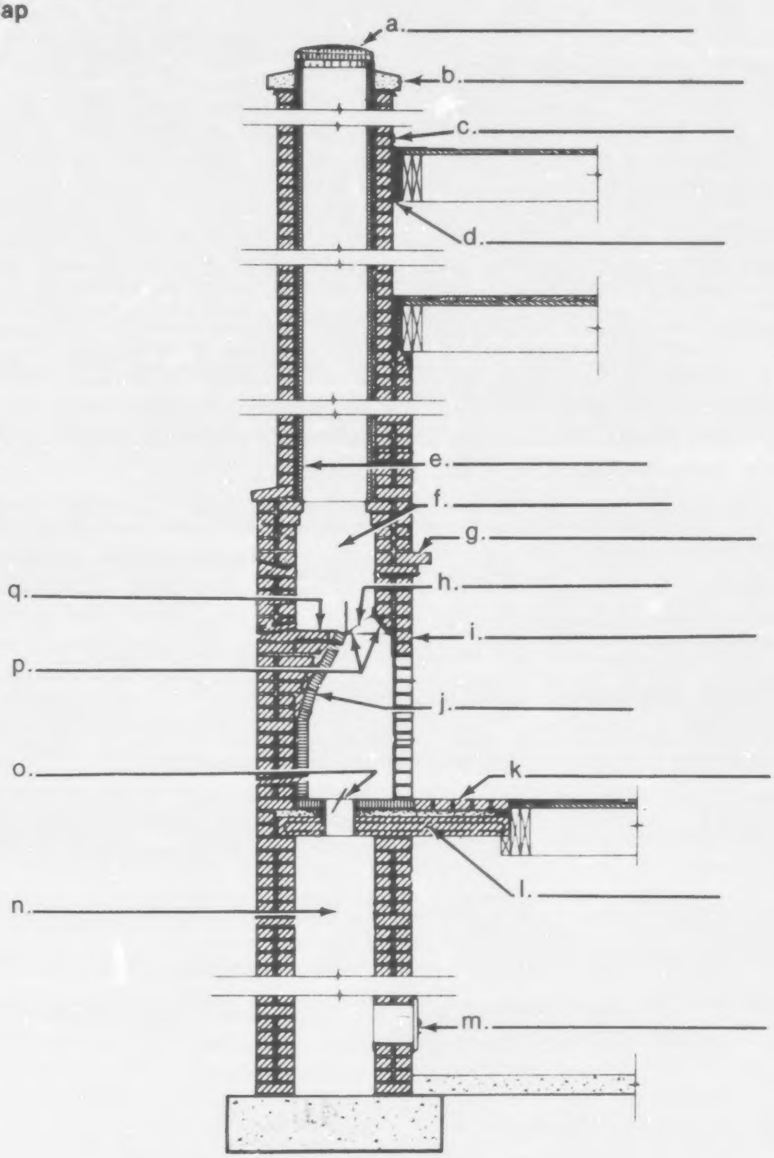


j. ________________

TEST

6. Identify the parts of the fireplace below. Write the correct names in the blanks.

**Ashpit**
**Flashing**
**Brick outer hearth**
**Spark arrester**
**Flue lining**
**Smoke chamber**
**Smoke shelf**
**Reinforced brick slab**
**Cap**
**Breast**
**Mantel**
**Throat**
**Cleanout**
**Fire stop**
**Damper**
**Firebrick**
**Ash dump**



## TEST

7. State four factors to consider when constructing chimneys and fireplaces.

   a. ______________________________________________

   ______________________________________________

   b. ______________________________________________

   ______________________________________________

   c. ______________________________________________

   ______________________________________________

   d. ______________________________________________

   ______________________________________________

8. Arrange in order procedures for applying fireclay to firebrick. Write a "1" in the blank pertaining to the first procedure, a "2" in the blank for the second, and so on.

   _____a. Pick up dry brick

   _____b. Spread fireclay evenly over all bonding surfaces

   _____c. Mix fireclay to a consistency of heavy whipped cream

   _____d. Apply fireclay to firebrick

9. Distinguish between firebrick clay mortar and brick mortar. Write an "F" in the blanks before firebrick clay mortar and a "B" in the blanks before brick mortar.

   _____a. Resists rain after hardening

   _____b. Contains cement, lime, sand, and water

   _____c. Is very plastic

   _____d. Cannot be used on exterior

   _____e. Does not require sand

   _____f. Can be used on interior or exterior

   _____g. Withstands intensive heat

   _____h. Is used for bonding brick and block

   _____i. Requires water

## TEST

10. State two characteristics of firebrick.

a. ____________________

b. ____________________

11. State characteristics of a firebox.

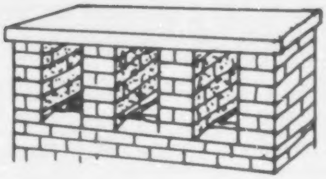
a. ____________________

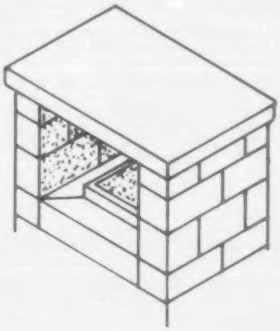
____________________

b. ____________________

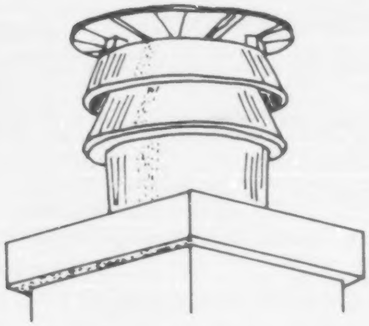
____________________

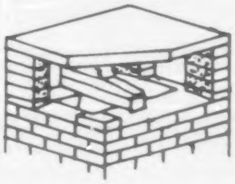
12. Label the following types of hoods.





a. ____________________ b. ____________________





c. ____________________ d. ____________________

# TEST

(NOTE: Test question 13 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

13. Demonstrate ability to

    a. Cut hole in flue liner.

    b. Install lining and lay up chimney.

    c. Construct a firebox.

    d. Construct a fireplace.

## CHIMNEYS AND FIREPLACES
## UNIT III

## ANSWERS TO TEST

1.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | 12 | f. | 8 | k. | 2 | p. | 18 |
| b. | 10 | g. | 4 | l. | 9 | q. | 15 |
| c. | 7 | h. | 11 | m. | 13 | r. | 17 |
| d. | 1 | i. | 5 | n. | 6 | s. | 19 |
| e. | 14 | j. | 3 | o. | 16 | | |

2. Answer should include — Function of the chimney is to produce the draft necessary to carry smoke and gases to the outside of the structure without endangering the structure or its occupants

3.
   a. Hood
   b. Flue lining
   c. Cap or wash
   d. Flashing
   e. Thimble
   f. Header
   g. Cleanout
   h. Footing
   i. Footing
   j. Cleanout
   k. Ashpit or open chamber
   l. Header
   m. Flue lining
   n. Thimble
   o. Cap or wash
   p. Spark arrester

4. Answer should include any three of the following
   a. Draft requirements
   b. Height
   c. Anticipated wind, earthquake, or blast loads
   d. Weight of chimney
   e. Stability and allowable bearing pressure of soil

## ANSWERS TO TEST

f. Expansion and contraction of chimney walls due to temperature changes of gases in flue

5. a. Cantilevered hearth
   b. Raised hearth
   c. Arched lintel
   d. Corner unit
   e. Three faces
   f. Two faces (adjacent)
   g. Firepit with hood
   h. Two faces (opposite)
   i. Combination unit
   j. Single face

6. a. Spark arrester
   b. Cap
   c. Flashing
   d. Fire stop
   e. Flue lining
   f. Smoke chamber
   g. Mantel
   h. Throat
   i. Breast
   j. Firebrick
   k. Brick outer hearth
   l. Reinforced brick slab
   m. Cleanout
   n. Ashpit
   o. Ash dump
   p. Damper
   q. Smoke shelf

7. Answer should include any four of the following
   a. Footing should be sufficient to support chimney and fireplace
   b. Fireplace should be laid out at its specified location maintaining lateral and vertical clearances
   c. Masonry below fireplace should be same perimeter as fireplace
   d. Size of specified damper should be same as finished fireplace opening
   e. Finished opening height should be less than width of finished opening of fireplace
   f. Bottom of damper should be 6 to 8 inches above top of finished opening
   g. Smoke shelf should be kept level with bottom of damper

## ANSWERS TO TEST

h. Damper should be measured at bottom of inside for fireplace opening and sides of firebox

i. Chimney should be 3 feet above highest point of roof where it passes through roof, and at least 2 feet higher than any portion of building that is within 10 feet of it

8. a. 2

b. 4

c. 1

d. 3

9. a. B

b. B

c. F

d. F

e. F

f. B

g. F

h. B

i. F

10. Answer should include any two of the following

a. Larger in size than regular brick

b. Resistant to high temperatures

c. Sensitive to moisture and cold

11. Answer should include

a. Slope of back throws flame forward and leads gases through throat with increasing velocity

b. Angle of sides gives maximum radiation of heat into room

12. a. Stone hood with walls for triple flue

b. Stone hood with walls for single flue

## ANSWERS TO TEST

- c. Metal chimney cap and hood
- d. Stone hood with corner post for double flue

13. Performance skills evaluated to the satisfaction of the instructor

# RELATED LAYOUT AND CONSTRUCTION
## UNIT IV

## UNIT OBJECTIVE

After completing this unit, the student should be able to lay out centers for various types of arches and install a section of sidewalk with paving brick in the herringbone pattern. The student will show this knowledge by completing assignment sheets, job sheet, and unit test with a minimum score of 85 percent.

## SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with layout and construction.
2. State purposes of arches in brick construction.
3. Label types of arches.
4. Match arch parts to their correct locations.
5. Label dimensions of an arch.
6. Describe method of finding radius point, given span and rise.
7. Arrange in order the procedures for laying out centers for Roman, segmental, elliptical, and Gothic arches.
8. State advantages of masonry paving.
9. Identify types of paving patterns.
10. Select from a list the basic parts of masonry paving.
11. State tasks that the bricklayer must be able to perform to install masonry paving.
12. State reasons for using glazed structural tile.
13. Identify types of glazed structural tile.
14. State purposes of grouting.
15. Name types of grout.
16. Name methods of grouting.
17. State guidelines for building cavity walls.

## OBJECTIVE SHEET

18. State guidelines for building reinforced masonry walls.
19. Match reinforcing-rod sizes to their correct numbers.
20. Select from a list purposes of insulation.
21. Name types of insulation used in masonry walls.
22. State methods of applying insulation.
23. State uses of corbeling.
24. State guidelines for constructing masonry corbels.
25. Lay out center for semicircular arch.
26. Lay out center for segmental arch.
27. Lay out center for elliptical arch.
28. Lay out center for Gothic arch.
29. Demonstrate the ability to install paving brick on a 4-by-6-foot section of sidewalk, using herringbone pattern.

## RELATED LAYOUT AND CONSTRUCTION
## UNIT IV

## SUGGESTED ACTIVITIES

I. Suggested activities

A. Obtain transparencies.

(NOTE: Transparencies are available from AGC and CIMC.)

B. Gather equipment and materials for job sheet demonstrations.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives.

E. Provide students with information, assignment, and job sheets.

F. Discuss information and assignment sheets.

G. Provide students with material and equipment necessary to complete assignment sheets.

H. Assign dimensions of arches to students so that they may complete the assignment sheets.

I. Demonstrate and discuss procedures outlined in job sheet.

J. Provide students with material and equipment necessary to accomplish procedures outlined in the job sheet.

K. Provide students with specifications and/or job plans for job sheets.

L. Give test.

M. Complete appropriate section of competency profiles.

(NOTE: Competency profiles are available from AGC and CIMC.)

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

## SUGGESTED ACTIVITIES

- D. Transparency masters
    1. TM #1 — Parts of an Arch
    2. TM #2 — Types of Structural Tile
    3. TM #3 — Types of Corbeling
- E. Assignment sheets
    1. Assignment Sheet #1 — Lay Out Center for Semicircular Arch
    2. Assignment Sheet #2 — Lay Out Center for Segmental Arch
    3. Assignment Sheet #3 — Lay Out Center for Elliptical Arch
    4. Assignment Sheet #4 — Lay Out Center for Gothic Arch
- F. Answers to assignment sheets
- G. Job Sheet #1 — Install Paving Brick on a 4-by-6-Foot Section of Sidewalk, Using Herringbone Pattern
- H. Test
- I. Answers to test

III. Unit references

A. Graham, Frank D. *Audel's Masons and Builders Guide,* Vol. 2. Indianapolis, Indiana, and New York: Theodore Audel and Co./Howard Sams and Co., Inc., 1967.

B. Kreh, R.T., Sr. *Masonry Skills*. Albany, New York: Delmar Publishers, Inc., 1982.

C. Roark, William F., and Harry C. Plummer. *Bricklaying Vocational Training.* McLean, Virginia: Brick Institute of America, 1973.

D. Taylor, Merlin, and Harland Randolph. *The Bricklayer,* Vol. I, *Brick and Block Construction.* Washington, D.C.: International Masonry Apprenticeship Trust, 1977.

E. *Technical Notes on Brick and Tile Construction*. McLean, Virginia: Brick Institute of America, n.d.

F. Turcotte, Raymond J. *Bricklaying.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1977.

# RELATED LAYOUT AND CONSTRUCTION
## UNIT IV

## INFORMATION SHEET

I. Terms and definitions

A. Abutment — Lower sides or piers that support an arch

B. Adhesive — Substance used to hold materials together by surface attachment

C. Arch — Curved structural or decorative member used to span an opening or recess; structural types support load over span in a manner similar to that of bond beams or lintels

D. Base — Foundation or support for masonry paving units; may be underlying stratum or concrete

E. Blowout — Swelling or rupture of a wall due to too much pressure

F. Center — Form cut or built to dimensions and shape of an arch; used in the opening to help support masonry while it is being laid (Figures 1 and 2)

EXAMPLES:

FIGURE 1

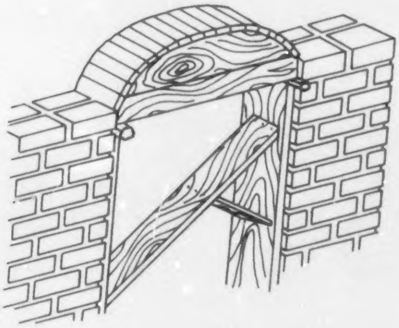
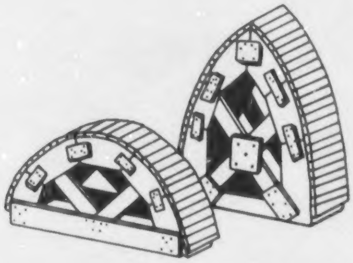


FIGURE 2



Figures 1 and 2 used with permission of the International Masonry Institute Apprenticeship and Training Program from *The Bricklayer: Brick and Block Construction*, by Merlin Taylor and Harland Randolph, 1977.

G. Compass — Instrument used to draw a circle or arc

H. Consistency — Relative density; ability of freshly mixed mortar or grout to flow

## INFORMATION SHEET

I. Cushion — Filler used under paving units; usually sand or mortar

J. Dry pack — Very dry mortar mix

(NOTE: Dry-pack mix is correct when a handful of mortar is squeezed together and then just sticks together with no apparent moisture.)

K. Flashing — Material used to help prevent moisture penetration

L. Gingerbread — Masonry trim designed by corbeling units in intricate patterns, usually at cornices of buildings

M. Glazed structural tile — Type of masonry unit with fire-hardened, glossy face; generally used for interior construction

N. Haunch — Portion of an arch between key brick and skewback

O. Insulation — Material used to protect structure from transfer of heat, cold, or sound

P. Membrane — Film that restricts evaporation of water and acts as vapor barrier or seal

Q. Perpendicular — Line at right angle to another line or surface

R. Puddle — To distribute and consolidate grout after it is poured into its final location

S. Radius — Any straight line extending from center of circle to arc

T. Radius point — Center of circle partially circumscribed by inner ring of arch

U. Reinforcing rods — Steel rods (usually deformed) embedded in mortar in such a way that the metal and mortar act together to resist forces

V. Right angle — Angle formed by two lines perpendicular to each other

W. Rise — Distance from center point of span to highest point of intrados

X. Slope — Downward slant or incline that allows water to drain off pavement

Y. Slump — Measure of mortar consistency

Z. Span — Width of arch

AA. Stratum — Undisturbed earth

BB. Stress — Intensity of force developed per unit area within a body in resisting forces acting on it

## INFORMATION SHEET

CC. Tamp — Tool with a square steel base to which a long vertical wooden handle is attached; used to compact materials such as dirt, concrete, and dry-pack mortar

DD. Vapor barrier — Material used to retard flow of vapor or moisture

EE. Weep holes — Small holes at base of masonry; used for drainage of masonry wall; usually spaced about 24 inches apart

II. Purposes of arches in brick construction

A. Bridging or spanning an opening

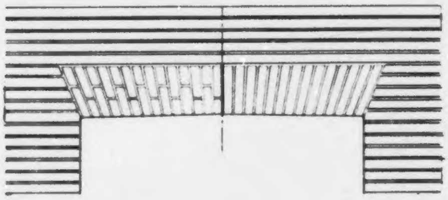
B. Sustaining weight

C. Ornamentation

III. Types of arches (Figures 3-9)

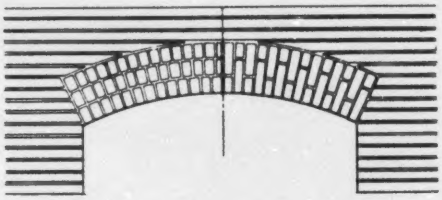
A. Jack

FIGURE 3



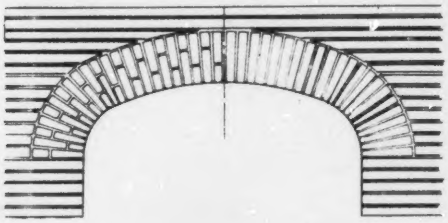
B. Segmental

FIGURE 4



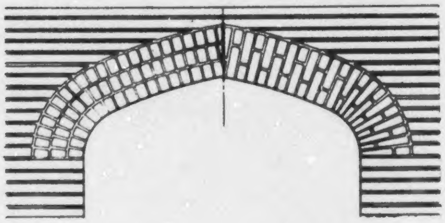
C. Elliptical or multicentered

FIGURE 5



D. Tudor

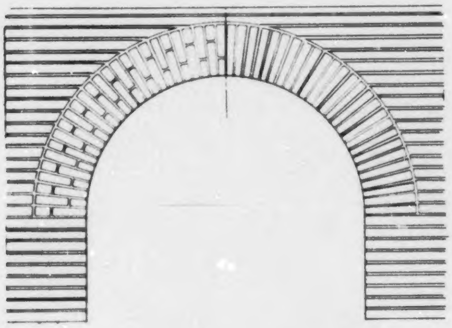
FIGURE 6



## INFORMATION SHEET

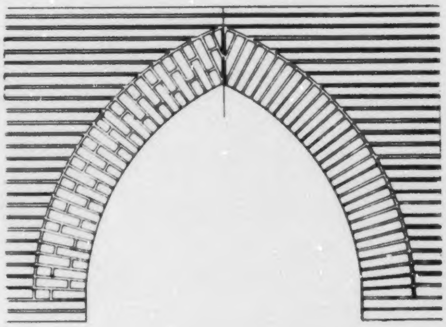
E. Roman or semicircular

FIGURE 7



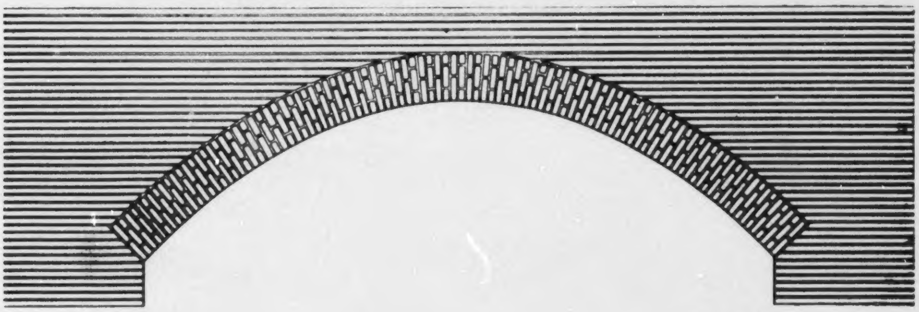
F. Gothic or pointed

FIGURE 8



G. Parabolic

FIGURE 9



IV. Arch parts and their locations (Transparency #1)

A. Abutment — Part of a structure that receives pressure of an arch

B. Apex or crown — Highest point of arch; located on center line of symmetrical arches

C. Arch ring — Area of an arch between intrados and extrados

D. Creeper — Unit between spandrel and arch ring that must be cut to close space between them

E. Extrados or outer ring — Upper curving line or convex curve that extends from one side of arch to other

(NOTE: This line or edge is used to measure the outside dimension of the arch ring.)

## INFORMATION SHEET

F. Haunch — Part of arch ring between key brick and end of arch ring (right or left side)

G. Intrados or inner ring — Bottom curving line or concave curve that extends from one side of arch to other

(NOTE: This line or edge is used to measure the inside dimension of the arch ring and to space arch brick within the ring.)

H. Jamb — Sides of abutment or pier that form opening under arch

I. Keystone or key brick — Unit that wedges arch brick into a secure position; centered in arch ring on center line

J. Skewback — Units between arch rings and adjacent units in abutment

(NOTE: These units must be cut to form a specified angle between the arch ring and skewback; to transmit load and prevent failure, the line must be perpendicular to the direction in which the arch will exert thrust or stress.)

K. Soffit — Surface or face on inner ring

L. Spandrel — Part of the wall above an arch and abutment

M. Springer — First unit at end of arch; placed against skewback at the spring point

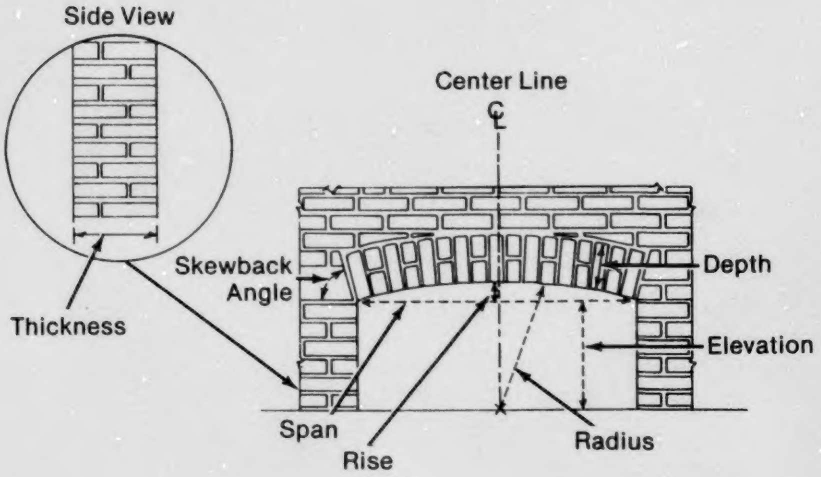
N. Spring point — Point of pressure between springer and skewback

O. Voussoir or arch brick — Units laid within arch ring

## INFORMATION SHEET

V. Dimensions of an arch (Figure 10)

FIGURE 10



Adapted with permission of the International Masonry Institute Apprenticeship and Training Program from *The Bricklayer: Brick and Block Construction*, by Merlin Taylor and Harland Randolph, 1977.

VI. Method of finding radius point, given span and rise

(NOTE: This method finds the radius point of a circle partially circumscribed by the inner ring of an arch. The method will work for any arch having only one radius.)

A. Divide span by 2

B. Multiply answer in A by itself

C. Divide answer in B by rise

D. Add answer in C to rise

E. Divide answer in D by 2 to find radius for arch

EXAMPLE: Find the radius point if the span is 60 inches and rise 12 inches.

60 ÷ 2 = 30
30 × 30 = 900
900 ÷ 12 = 75
75 + 12 = 87
87 ÷ 2 = 43.5
Radius for arch = 43 1/2"

## INFORMATION SHEET

F. Mark radius point by measuring length of radius along center line, beginning at top point of rise (Figure 11)

EXAMPLE: Find the radius if the span is 60 inches and rise 12 inches.

$60 \div 2 = 30$

$30 \times 30 = 900$

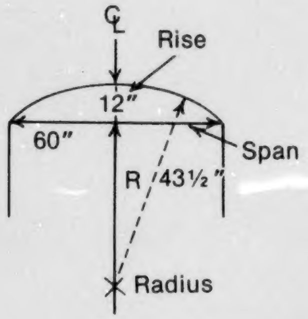
$900 \div 12 = 75$

$75 + 12 = 87$

$87 \div 2 = 43.5$

Radius for arch = 43½″

FIGURE 11



VII. Procedures for laying out centers for Roman, segmental, elliptical, and Gothic arches (Assignment Sheets #1-#4)

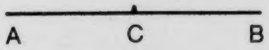
(NOTE: The specific procedures for each of these arches vary, but they follow a general pattern.)

A. Read plans for proper dimensions

B. Draw span line on a sheet of plywood; use letters to label end points and center (Figure 12)

EXAMPLE:

FIGURE 12

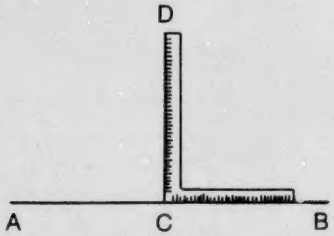


C. Use framing square to draw the rise (Figure 13)

(NOTE: The rise will be at a right angle to the span.)

EXAMPLE:

FIGURE 13



## INFORMATION SHEET

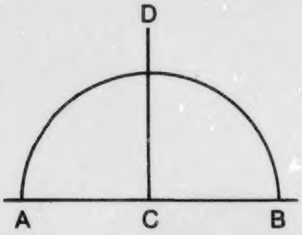
D. Use proper procedure to determine radius point

E. Draw arc for intrados ring (Figure 14)

(NOTE: Set a compass equal to the radius; fix one end on radius point, and draw arc. The arc must intersect the span line on both sides and pass through the rise.)

EXAMPLE:

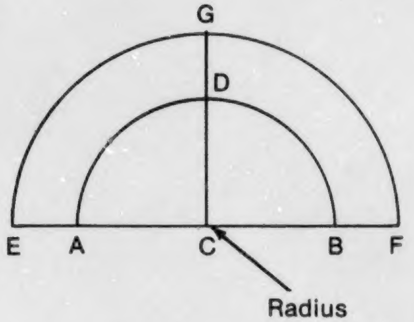
FIGURE 14



F. Extend span line on both ends the depth of arch, and draw arc for extrados ring (Figure 15)

EXAMPLE:

FIGURE 15



G. Use spacing rule and radius to outline units and spacing

H. Cut out pattern (template) of each arch brick

VIII. Advantages of masonry paving

A. Provides durable surface

B. Adds to appearance

C. Is economical

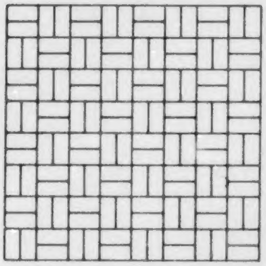
## INFORMATION SHEET

- D. Adds color
- E. Can be placed in mortar and jointed with mortar
- F. Can be placed without mortar
- G. May be used for interior or exterior paving
- H. May be used for wide variety of jobs

IX. Types of paving patterns (Figures 16-26)

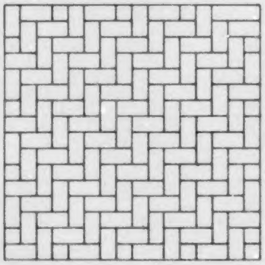
A. Basket weave

FIGURE 16



B. Herringbone

FIGURE 17



C. Variations of basket weave

FIGURE 18

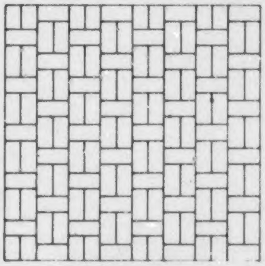
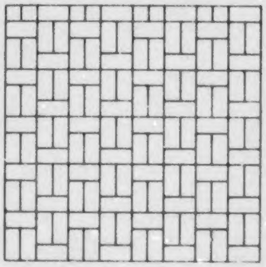
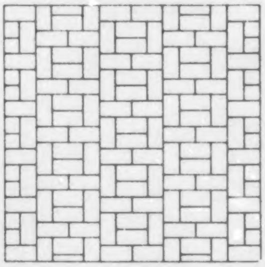


FIGURE 19



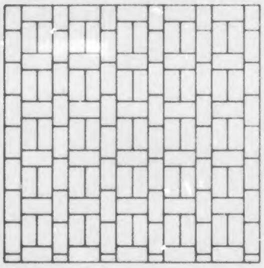
## INFORMATION SHEET

FIGURE 20



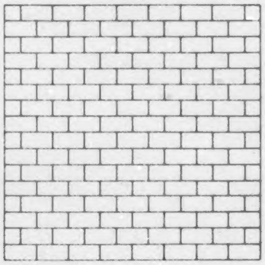
D. Running bond

FIGURE 21



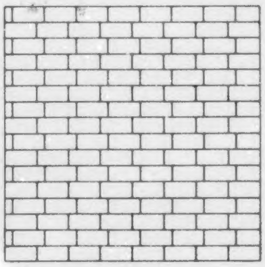
E. One-quarter running bond

FIGURE 22



F. Running and stack bond mixed

FIGURE 23



G. Stack bond

FIGURE 24

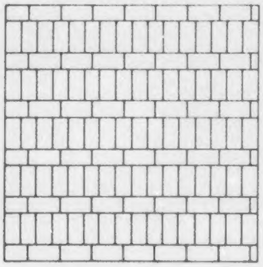
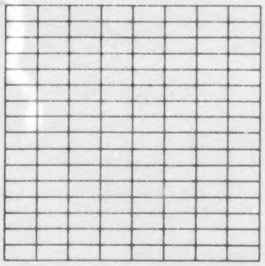


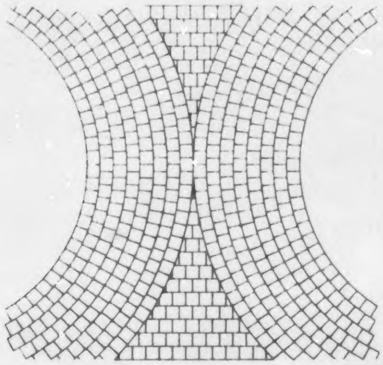
FIGURE 25



## INFORMATION SHEET

H. Circular and running bond mixed

FIGURE 26



X. Basic parts of masonry paving

- A. Base
- B. Cushion
- C. Membrane
- D. Wearing surface

XI. Tasks that the bricklayer must be able to perform to install masonry paving

- A. Read plans
- B. Follow working drawings to plan work
- C. Lay out section of work to plan total job
- D. Prepare base
- E. Lay cushion that allows proper leveling and support of surface units
- F. Lay surface units to finish grade and slope
- G. Align units in specified pattern bond
- H. Clean, finish, and protect finished product

## INFORMATION SHEET

XII. Reasons for using glazed structural tile

A. Can be easily cleaned

B. Is stain resistant

C. Requires low maintenance

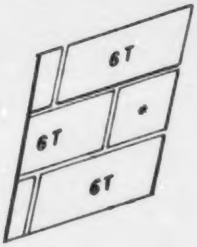
D. Allows color selection

(NOTE: Glazed structural tile comes in a wide range of colors.)

XIII. Types of glazed structural tile (Figures 27-32; Transparency #2)

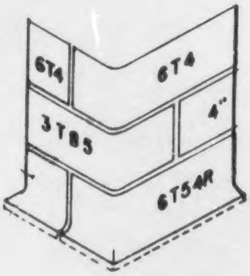
A. Stretcher

FIGURE 27



B. Bullnose

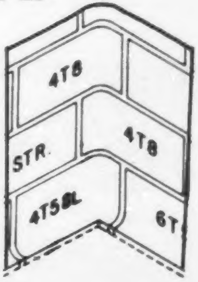
FIGURE 28



## INFORMATION SHEET

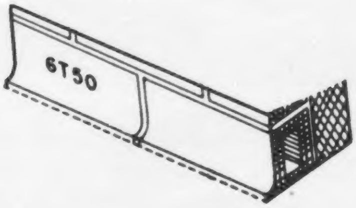
C. Cove corner

FIGURE 29


4T8
STR.
4T8
4T58L
6T

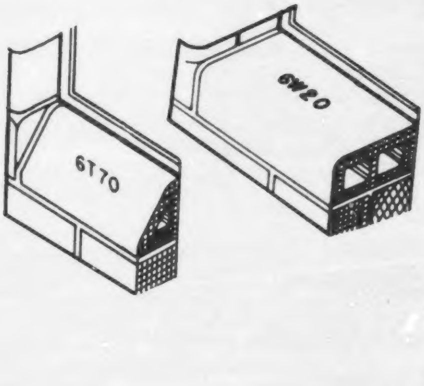
D. Cove base

FIGURE 30



E. Sill

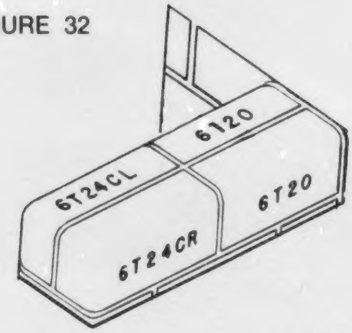
FIGURE 31



## INFORMATION SHEET

F. Cap

FIGURE 32



XIV. Purposes of grouting

A. Providing strength

B. Providing resistance to moisture penetration

C. Providing resistance to heat and cold

D. Providing resistance to expansion and contraction

E. Providing resistance to cracking of mortar joints and units

XV. Types of grout

A. Mortar

B. Fine grout

(NOTE: Fine grout is used when cavity opening does not exceed width of 2 ½ inches; a coarse sand is used in the mix.)

C. Coarse grout

(NOTE: Coarse grout is used when cavity opening is more than 2 ½ inches wide; usually ⅜-inch aggregate is used in this mix.)

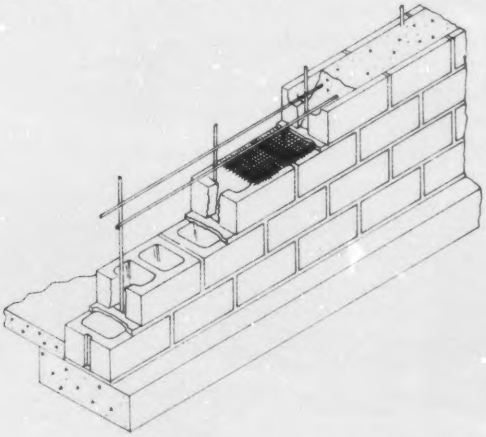
## INFORMATION SHEET

XVI. Methods of grouting

A. Low lift (Figure 33)

(NOTE: In low-lift grouting, one wythe of wall is laid up about 3 courses high. Then grout is poured into cavities. Grout is puddled as it is poured into the cavity. About fifteen minutes between each pouring is allowed to avoid the possibility of blowouts.)

FIGURE 33

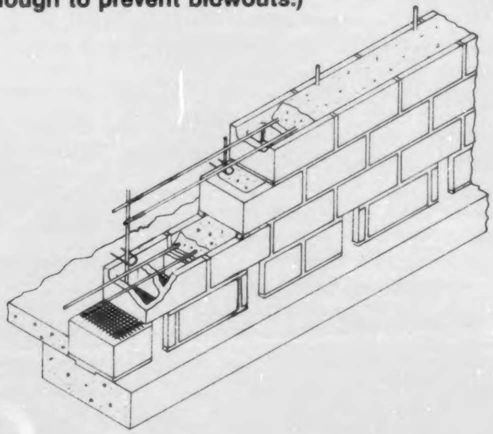


B. High lift (Figure 34)

(NOTE: High-lift grouting involves building the wall to specified height and then pouring grout into the cavities.)

**(CAUTION: Do not pour grout into walls greater than 9 feet high. Do not pour more than a 4-foot height at any one time. Do not fill until masonry is strong enough to prevent blowouts.)**

FIGURE 34



## INFORMATION SHEET

XVII. Guidelines for building cavity walls

- A. Install flashing at base of wall, over openings, and under sills
- B. Install weep holes every 24 to 32 inches
- C. Keep cavity clean
- D. Bevel bed joint mortar
- E. Use proper ties and proper tie placement
- F. Use proper mortar
- G. Use specified insulation, properly installed

XVIII. Guidelines for building reinforced masonry walls

- A. Install proper reinforcing steel
- B. Use grout of proper consistency (9- to 12-inch slump)
- C. Puddle grout to consolidate it
- D. Use solid, beveled, nonfurrowed bed joints
- E. Use full head joints

  (NOTE: Full head joints are made by applying mortar to the ends of each unit and shoving units forcefully into place.)

XIX. Reinforcing-rod numbers and sizes

- A. Rod #2 — 1/4-inch diameter
- B. Rod #3 — 3/8-inch diameter
- C. Rod #4 — 1/2-inch diameter
- D. Rod #5 — 5/8-inch diameter
- E. Rod #6 — 3/4-inch diameter
- F. Rod #7 — 7/8-inch diameter
- G. Rod #8 — 1-inch diameter
- H. Rod #9 — 1 1/8-inch diameter
- I. Rod #10 — 1 1/4-inch diameter

## INFORMATION SHEET

XX. Purposes of insulation

- A. Conserving energy
- B. Reducing cost of heating and cooling
- C. Reducing sound transmission
- D. Minimizing heat loss through walls
- E. Increasing year-round comfort

XXI. Types of insulation used in masonry walls

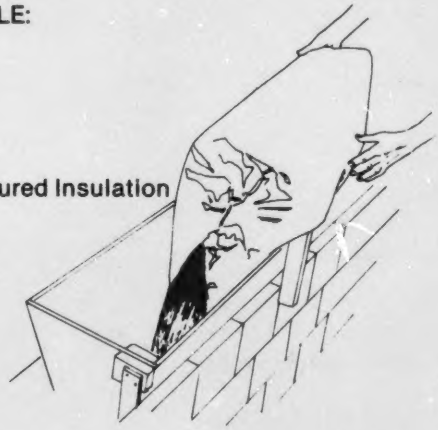
- A. Water-repellent vermiculite masonry fill
- B. Silicone-treated perlite loose fill
- C. Molded polystyrene
- D. Expanded polyurethane
- E. Rigid urethane
- F. Cellular glass
- G. Preformed fiberglass
- H. Perlite board

XXII. Methods of applying insulation (Figures 35-38)

- A. Pouring granular insulation into cores and cavities

EXAMPLE:

FIGURE 35

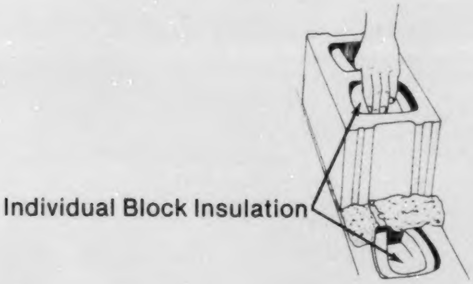


## INFORMATION SHEET

B. Inserting polystyrene into block cores

EXAMPLE:

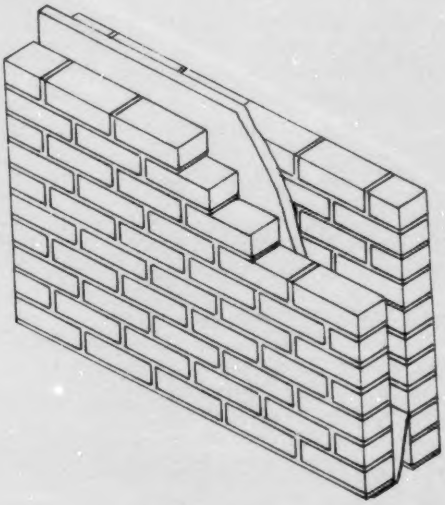
FIGURE 36


Individual Block Insulation

C. Applying rigid insulation with adhesive

EXAMPLE:

FIGURE 37

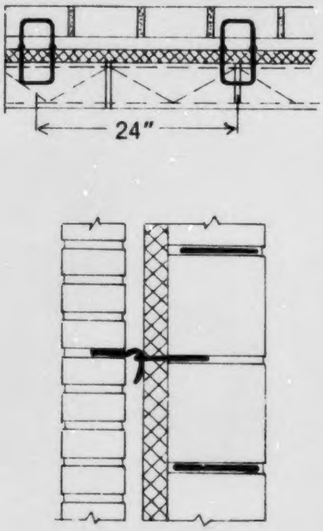


## INFORMATION SHEET

D. Applying rigid insulation with adjustable wall ties

EXAMPLE:

FIGURE 38



XXIII. Uses of corbeling (Transparency #3)

A. Thickening a wall to suit a particular job condition or requirement

B. Forming a ledge to hold items such as flue liners or mantels on fireplaces

C. Decorating structure

EXAMPLES: Gingerbread work at tops of older buildings; cornices and caps for chimneys

XXIV. Guidelines for constructing masonry corbels

A. Do not overlap or extend bricks of each projecting course by more than one-half brick width or one-third bed height

(NOTE: Corbeling must be gradual, with each course projecting ¾ inch to 2 inches over previous course.)

B. Use good bonding practices

(NOTE: Fill mortar joints well to ensure that projection remains stable.)

## INFORMATION SHEET

C. Use headers extensively

(NOTE: They add greater strength by tying further into wall.)

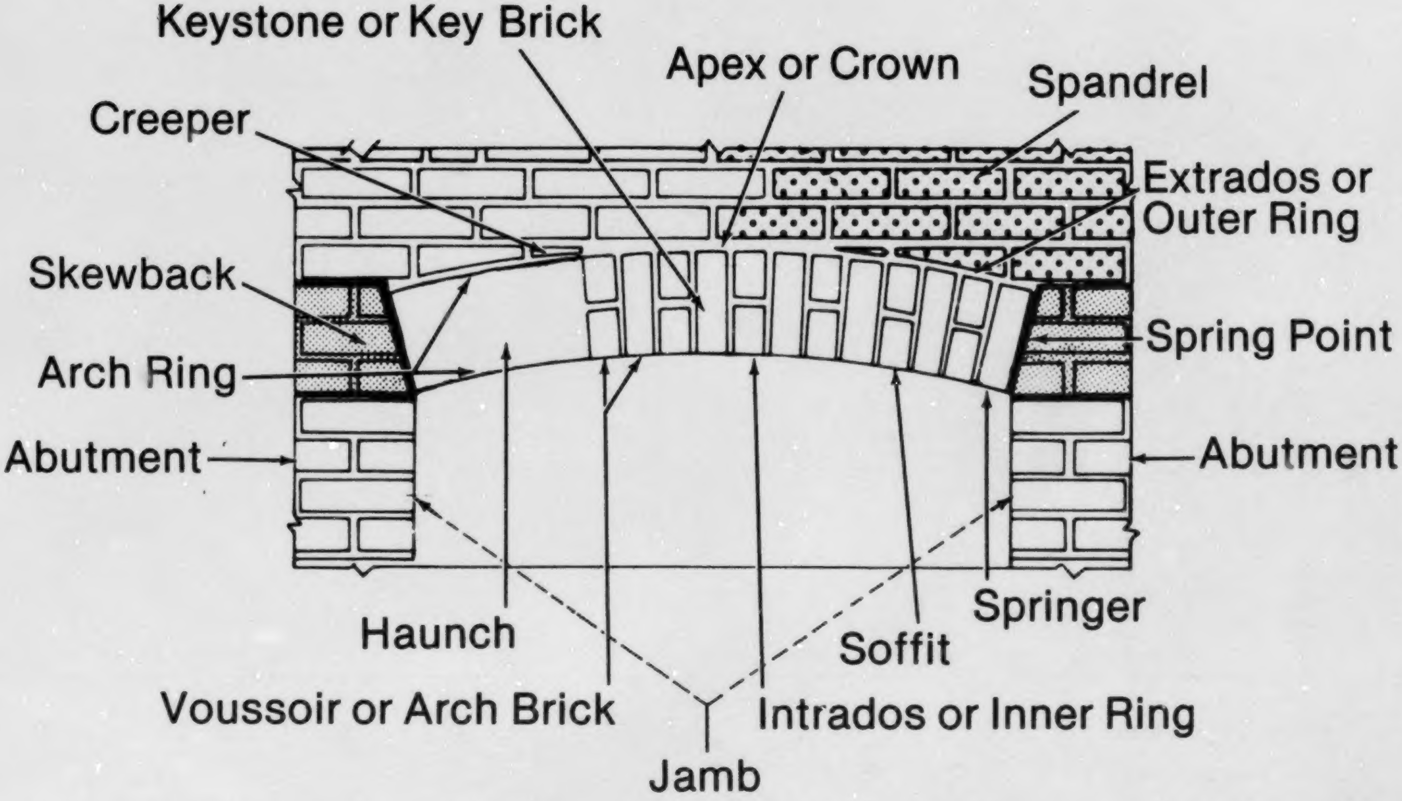
D. Use only bricks that are dry and free of chips or cracks

(NOTE: Most edges of the brick are exposed in corbels.)

E. Avoid working too fast

(NOTE: Excessive speed may defeat the purpose of the job and result in shoddy work.)

# Parts of an Arch


Keystone or Key Brick
Apex or Crown
Spandrel
Creeper
Extrados or Outer Ring
Skewback
Spring Point
Arch Ring
Abutment
Abutment
Haunch
Springer
Soffit
Voussoir or Arch Brick
Intrados or Inner Ring
Jamb

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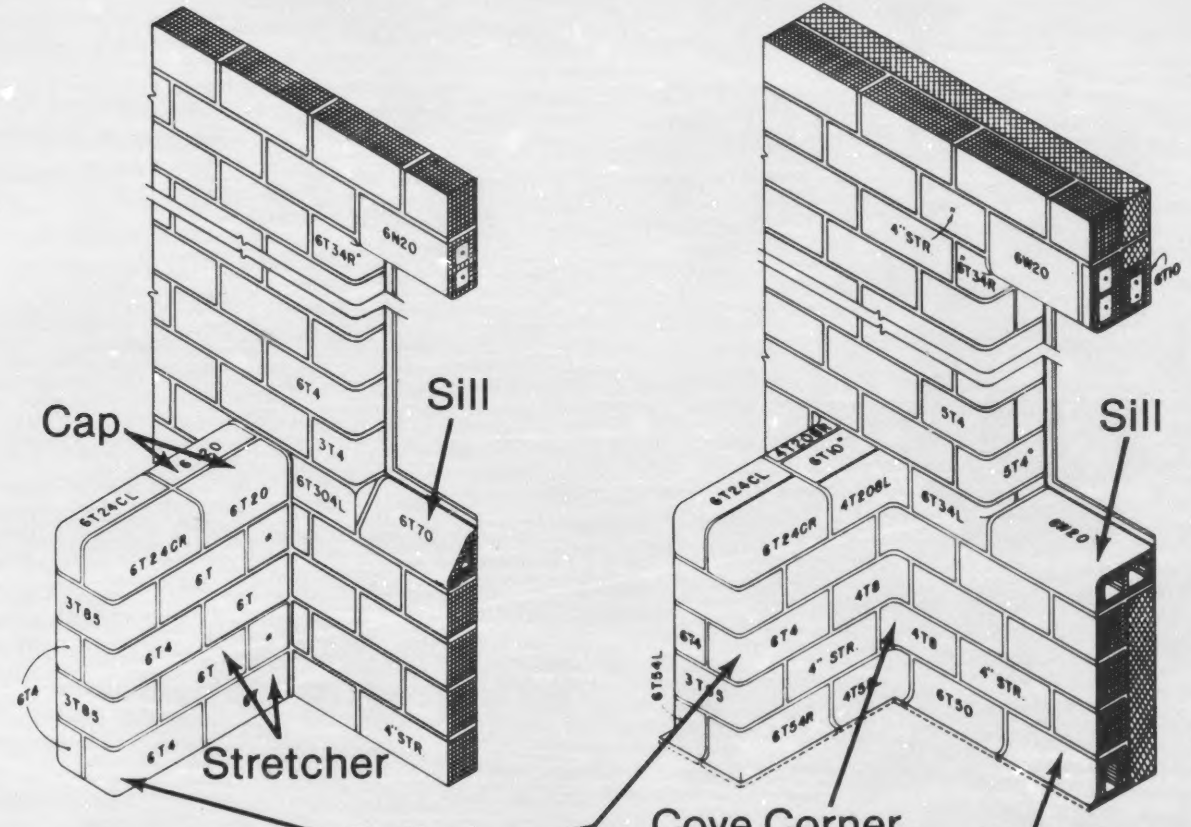
TM #1

PBL - 227-C

# Types of Structural Tile



6N20
6T34R
6T4
3T4
6T304L
6T70
6T24CL
6T20
6T24CR
6T
3T85
6T4
6T
6T4
4"STR.
4" STR.
6W20
6T34R
6T10
5T4
5T4
4T20BL
6T10
6T24CL
4T208L
6T34L
6W20
6T24CR
4T8
4T8
6T4
4" STR.
4" STR.
3T85
4T5
6T54L
6T54R
6T50

Cap

Sill

Stretcher

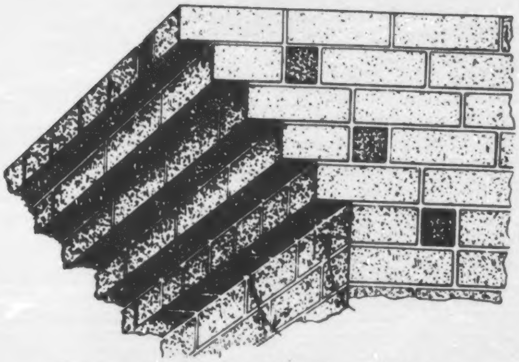
Bullnose

Cove Corner

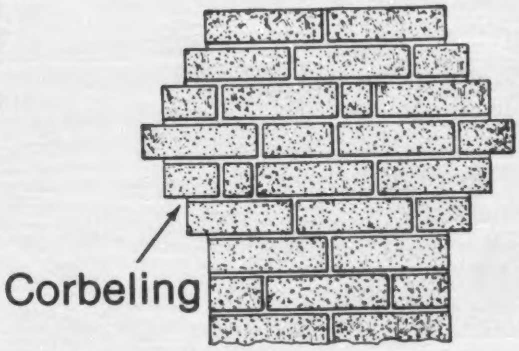
Sill

Cove Base

# Types of Corbeling

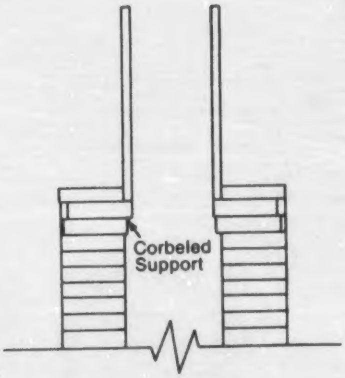


Ornamental Cornice



Chimney Cap

Used with permission of The Bobbs-Merrill Company, Inc., from *Audels Masons and Builders Guide #2*, copyright 1963.


Corbeled Support

Flue Liner Support

# RELATED LAYOUT AND CONSTRUCTION
## UNIT IV

## ASSIGNMENT SHEET #1 — LAY OUT CENTER FOR SEMICIRCULAR ARCH

NAME ______________________________ SCORE ______________

The accurate layout of centers is essential to the proper construction of arches. By using the span, rise, and radius, the bricklayer can lay out a center. The procedures for laying out the various types of arches are different, and each type must be drawn in strict accordance with plan dimensions and accepted trade practices.

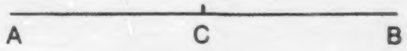
A Roman or semicircular arch forms half of a circle. In this arch, the center of the circle and the radius point are at the intersection of the center line and span.

Lay out the center for a Roman arch, using procedures outlined in Section VII of the Information Sheet and dimensions provided by the instructor.

(NOTE: If the purpose for laying out the center is to build a center to support the arch, only procedures A and B are required. If units must be precut or if layout is to determine best spacing and bonding pattern, complete all five procedures.)

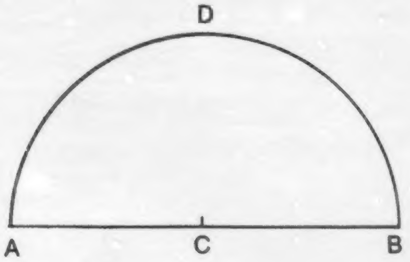
A. Draw span line A-B and locate center point C.

EXAMPLE:



B. Draw intrados D by using point C as the center and line A-C as the radius.

EXAMPLE:

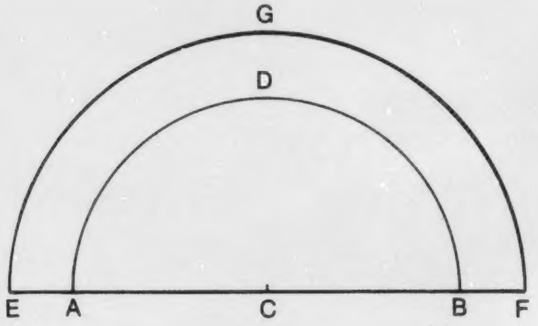


(NOTE: Stop here if center is to be used for support only.)

## ASSIGNMENT SHEET #1

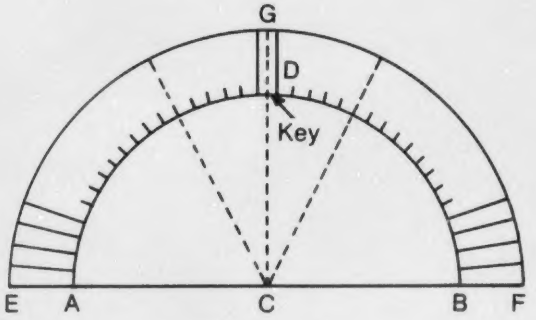
C. Draw extrados G by extending line A-B on both ends to points E and F by depth of arch and using radius E-C to scribe the arc.

EXAMPLE:



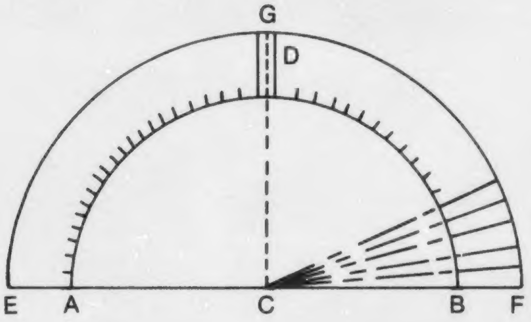
D. Mark off spacing for masonry units, including joints, on intrados; start with keybrick; then work up from each skewback.

EXAMPLE:



E. Sketch outline of courses by drawing lines from radius point C to course marks on intrados and extending lines to extrados.

EXAMPLE:



# RELATED LAYOUT AND CONSTRUCTION
## UNIT IV

## ASSIGNMENT SHEET #2 — LAY OUT CENTER FOR SEGMENTAL ARCH

NAME ________________________________ SCORE ______________

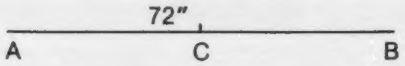
The proper construction of an arch depends to a large extent on accurate layout of the center. The outline of the center must be drawn accurately on the plywood. If the center is incorrect, the arch will not be proper and may fail to perform as designed.

The segmental arch is less than one-half of a circle. All points on its arc are the same distance from its radius point (center of the circle). The rise is one-fourth of the span.

Lay out the center for a segmental arch, using procedures outlined in Section VII of the Information Sheet. Use 72 inches as the span and 18 inches for the rise.

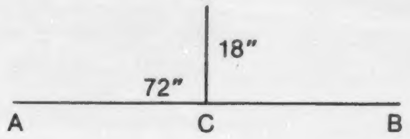
A. Draw span line from point A to point B; mark center of span line as point C.

EXAMPLE:



B. Measure specified rise at a 90-degree angle to span directly above point C; mark the rise as point D.

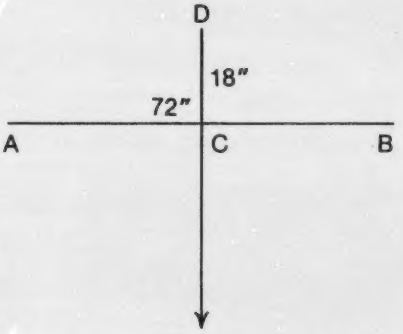
EXAMPLE:



## ASSIGNMENT SHEET #2

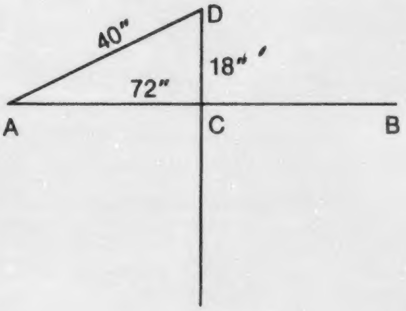
C. Draw a line from point D through center of span; extend it down approximately twice the distance that it extends above span.

EXAMPLE:



D. Draw a straight line connecting point A to point D (from end of span to rise).

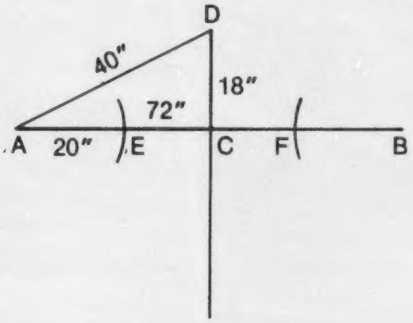
EXAMPLE:



E. Measure distance from A to D; divide distance A to D by 2.

F. Cut a string the length of half the distance from A to D; hold one end of string at point A and stretch it along span line, drawing an arc across span line at point E.

EXAMPLE:



## ASSIGNMENT SHEET #2

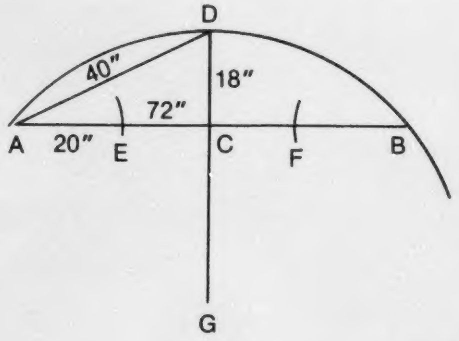
G. Repeat steps D, E, and F, using points B and D, to find point F.

H. Use points E and F as centers and line E-F as radii to draw arcs that intersect center line at point G.

I. Drive a nail into point G (radius point); tie a string to this nail, place a pencil on point D, and wrap string around pencil after stretching string tight.

J. Use string and pencil as a compass to draw an arc from point A to point B, passing through point D.

EXAMPLE:



K. Check all measurements to be sure that they are accurate; check radius at several points along the arc.

# RELATED LAYOUT AND CONSTRUCTION
## UNIT IV

## ASSIGNMENT SHEET #3 — LAY OUT CENTER FOR ELLIPTICAL ARCH

NAME ____________________ SCORE ____________

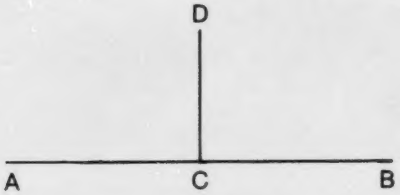
Several arcs are combined to form the curvature for multicentered or elliptical arches. The several arcs meet at intersections. There are several radius points on this type of arch.

Careful planning and accuracy in layout and construction are important in this type of arch because of the combined arcs.

Lay out the center for an elliptical arch, using procedures outlined in Section VII of the Information Sheet and dimensions provided by your instructor.

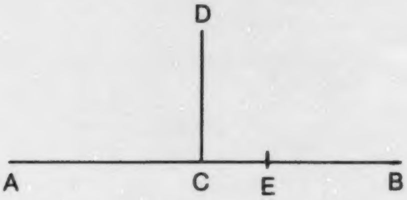
A. Draw span A-B and rise C-D.

EXAMPLE:



B. Mark point E on the span line at a distance from point A that is twice that of the rise C-D.

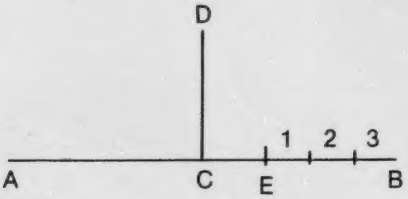
EXAMPLE:



## ASSIGNMENT SHEET #3

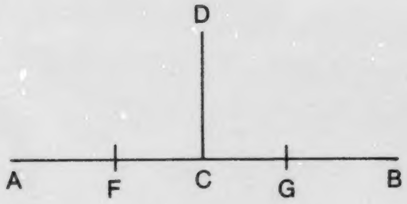
C. Divide distance between point E and point B into three equal parts.

EXAMPLE:



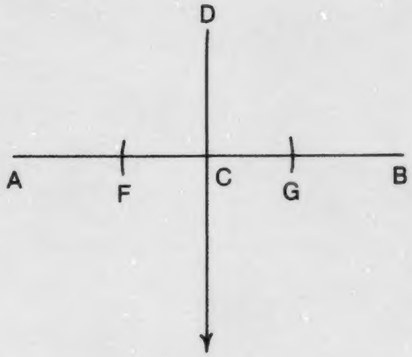
D. Measure two of the three parts; and using this distance as radius, center on point C, and mark points F and G on the span.

EXAMPLE:



E. Extend line D-C along center line toward bottom of center.

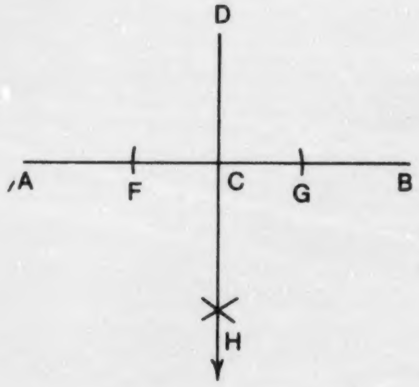
EXAMPLE:



## ASSIGNMENT SHEET #3

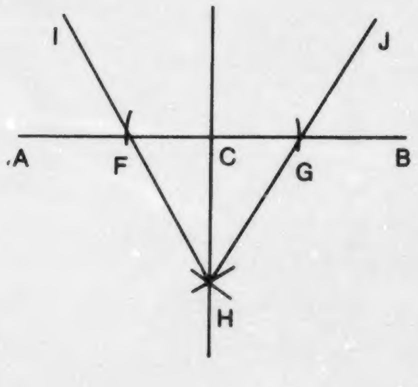
F. Use points F and G as centers and line F-G as radii to draw arcs that intersect center line at point H.

EXAMPLE:



G. Draw a line from point H to point F and extend it; then draw a line from point H to point G and extend it.

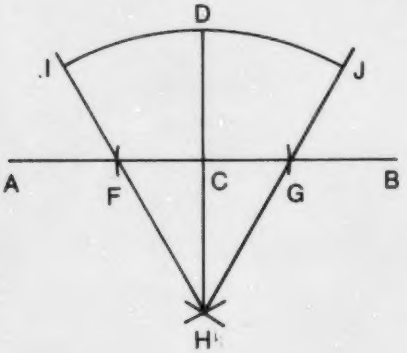
EXAMPLE:



## ASSIGNMENT SHEET #3

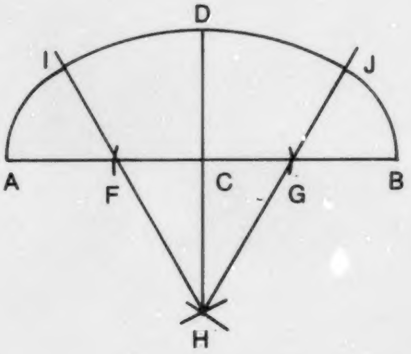
H. Measure distance from point D to point H to find another radius; use H as radius point to draw an arc from the extension of H-F (point I) through D to the extension of H-G (point J).

EXAMPLE:



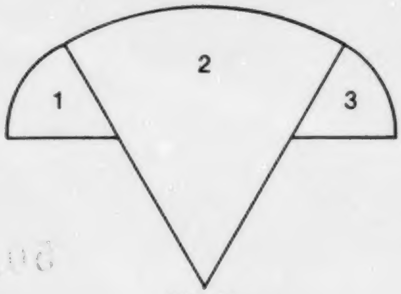
I. Use line A-F as radius and point F as radius point to draw an arc from A to I; then use line G-B as radius and point G as radius point to draw an arc from B to J.

EXAMPLE:



J. To lay out and lay up units, use the proper radius for that particular part of the arch.

EXAMPLE:



## RELATED LAYOUT AND CONSTRUCTION
## UNIT IV

## ASSIGNMENT SHEET #4 — LAY OUT CENTER FOR GOTHIC ARCH

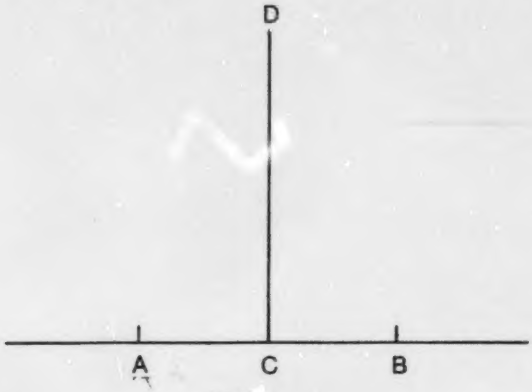
NAME ____________________ SCORE ____________

Bricklayers should have a working knowledge of center layout. On major projects, manufactured centers will be delivered, or centers will be made by related crafts. On small jobs, however, the bricklayer may construct the center, as well as lay out and then construct the arch. Knowledge of and skill in laying out centers will assist the bricklayer in proper bonding, laying up the arch, and cutting arch brick.

The arcs of two circles are used to lay out Gothic or pointed arches. The radii of those circles may be equal to, more than, or less than the span of the arch. The crown may be formed by a joint or keystone.

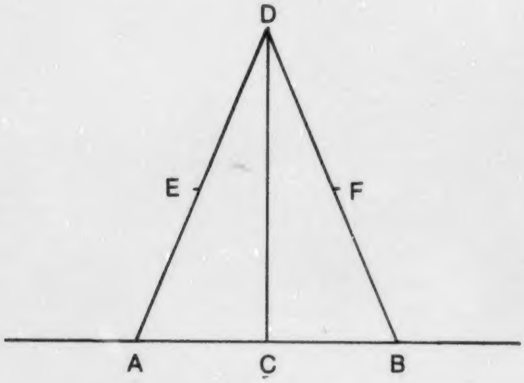
Lay out the center for a Gothic arch, using procedures outlined in Section VII of the Information Sheet and dimensions provided by your instructor.

A. Draw span line A-B; then mark center C and draw rise line C-D.

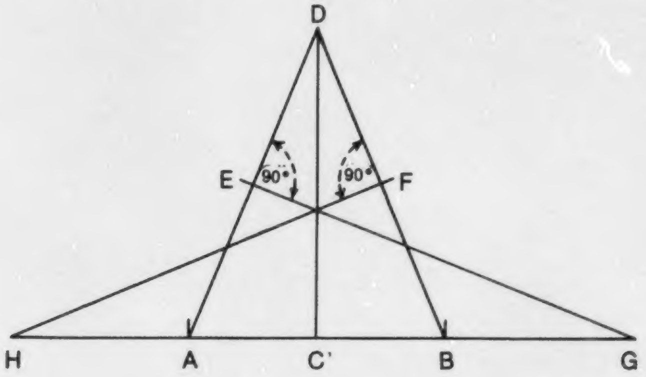


## ASSIGNMENT SHEET #4

B. Draw lines from A to D and B to D; mark center point E of line A-D and center point F of B-D. Extend line A-B at both ends.

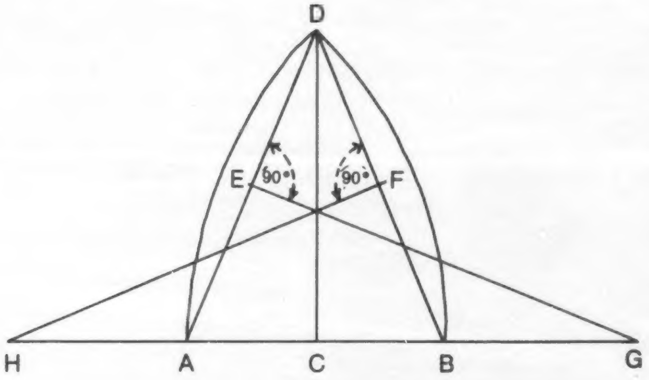


C. Draw line from E at right angle to A-D until it touches line A-B at point G; do the same from F to establish point H.



## ASSIGNMENT SHEET #4

D. Using H-B as radius, draw an arc from B to D; then using G-A as radius, draw an arc from A to D.



E. Lay out brick spacing, using radius point G to lay out spacing for left side and radius point H to lay out spacing for right side.

# RELATED LAYOUT AND CONSTRUCTION
## UNIT IV

## ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 — Evaluated to the satisfaction of the instructor

Assignment Sheet #2 — Evaluated to the satisfaction of the instructor

Assignment Sheet #3 — Evaluated to the satisfaction of the instructor

Assignment Sheet #4 — Evaluated to the satisfaction of the instructor

# RELATED LAYOUT AND CONSTRUCTION
# UNIT IV

## JOB SHEET #1 — INSTALL PAVING BRICK ON A 4-BY-6-FOOT SECTION OF SIDEWALK, USING HERRINGBONE PATTERN

I. Equipment and materials

  A. Brick trowel

  B. Brick hammer

  C. Brick set

  D. Bricklayer's level

  E. Rule or tape

  F. Bricklayer's brush

  G. Nylon water brush

  H. Framing square

  I. Claw hammer and 16d nails

  J. Wooden float

  K. Tamp or wood block

  L. Piece of 3/4-inch plywood about 16 inches square

  M. Rubber mallet

  N. Straightedge about 4 feet, 4 inches long with both ends notched out 2 1/4 inches deep

  O. Mortarboard and stand

  P. Mortar box, hoe, and square-point shovel

  Q. Wheelbarrow

  R. Water, water hose, and bucket

  S. Bag of sand

  T. 114 paving bricks, 3 5/8" × 7 5/8" × 2 1/4", including 5 percent for waste

  U. 2 bags portland cement

## JOB SHEET #1

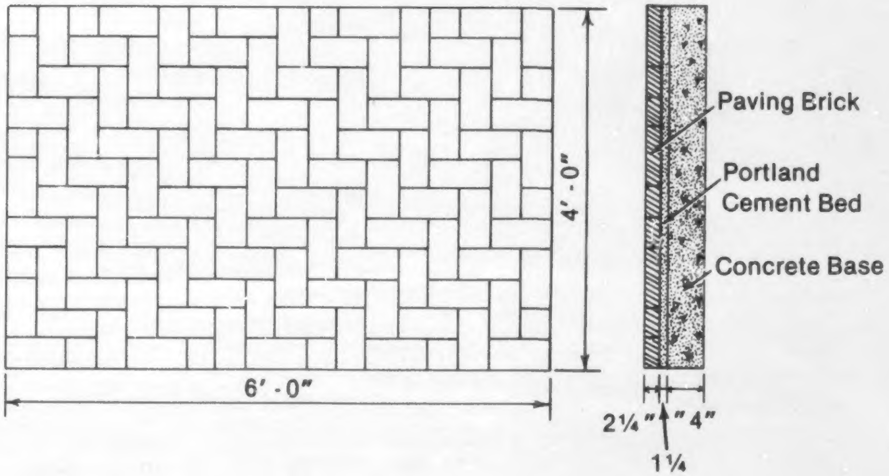
V. 1/2 ton sand

W. Two 4-foot long two-by-fours

X. Two 6-foot 4-inch long two-by-fours

Y. Specifications furnished by instructor (Figure 39)

FIGURE 39


4' - 0"
6' - 0"
Paving Brick
Portland Cement Bed
Concrete Base
2¼"
"4"
1¼

II. Procedure

A. Lay two-by-fours on top of concrete slab and nail them together to form a 4-by-6-foot rectangular frame

B. Square frame

(NOTE: It may be necessary to nail cleats along side of form to hold it in place.)

C. Mix portland cement mortar; use a 1:6 mix or mix as specified

(NOTE: Use a dry-pack mix for the mortar.)

D. Load mortar into wheelbarrow and transport to work site

## JOB SHEET #1

E. Use shovel to place mortar in forms

F. Place enough mortar to cover bottom about 1 inch thick

G. Use float to spread and compact mortar; then use tamp or wood block to tamp it tightly

H. Place compacted mortar within 2 $^{1}/_{4}$ inches of top of form

I. Use straightedge to check depth and level of mortar bed

(NOTE: Mortar must be well packed, especially in the corners and along edges. Surface must be smooth, flat, and recessed 2 $^{1}/_{4}$ inches from top of the form.)

J. Sprinkle dry portland cement evenly over surface of mortar bed about $^{1}/_{4}$ inch thick

(NOTE: Cement will absorb moisture from mortar bed, and thus provide a good bond for the paving brick.)

K. Install paving bricks, starting at one end

(NOTE: Brick must be damp in order to provide a good bond.)

L. Place first brick in position and tap down lightly with trowel handle

(NOTE: Sometimes it is necessary to use a wood block and mallet to set the brick. Use caution to avoid breaking brick.)

M. Continue setting bricks, maintaining proper spacing and pattern

(NOTE: Maintain $^{3}/_{8}$-inch joint spacing or maintain joint width specified.)

N. Sprinkle water lightly over surface if cement becomes dry

O. Check alignment, spacing, and level of brick as job progresses

(NOTE: Sometimes it is necessary to place a large piece of wood on sections of brick and tap it down in order to get all bricks flush with each other.)

P. Continue to set bricks until project is complete

Q. Clean tools and area around sidewalk

R. Allow brick to cure twenty-four to seventy-two hours before grouting

# RELATED LAYOUT AND CONSTRUCTION
## UNIT IV

## TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with layout and construction. Write the correct numbers in the blanks. Terms and definitions are continued on the following page.

______a. Width of arch

______b. Undisturbed earth

______c. Material used to help prevent moisture penetration

______d. Filler used under paving units; usually sand or mortar

______e. Any straight line extending from center of circle to arc

______f. Lower sides or piers that support an arch

______g. Downward slant or incline that allows water to drain off pavement

______h. Swelling or rupture of a wall due to too much pressure

______i. Distance from center point of span to highest point of intrados

______j. Instrument used to draw a circle or arc

______k. Foundation or support for masonry paving units; may be underlying stratum or concrete

______l. Type of masonry unit with fire-hardened, glossy face; generally used for interior construction

______m. Small holes at base of masonry; used for drainage of masonry wall; usually spaced about 24 inches apart

______n. Curved structural or decorative member used to span an opening or recess; structural types support load over span in a manner similar to that of bond beams or lintels

1. Cushion
2. Rise
3. Glazed structural tile
4. Slope
5. Compass
6. Span
7. Flashing
8. Base
9. Radius
10. Weep holes
11. Stratum
12. Arch
13. Abutment
14. Blowout

## TEST

______o. To distribute and consolidate grout after it is poured into its final location

______p. Material used to protect structure from transfer of heat, cold, or sound

______q. Form cut or built to dimensions and shape of an arch; used in the opening to help support masonry while it is being laid

______r. Steel rods (usually deformed) embedded in mortar in such a way that the metal and mortar act together to resist forces

______s. Angle formed by two lines perpendicular to each other

______t. Material used to retard flow of vapor or moisture

______u. Portion of an arch between key brick and skewback

______v. Relative density; ability of freshly mixed mortar or grout to flow

______w. Line at right angle to another line or surface

______x. Measure of mortar consistency

______y. Intensity of force developed per unit area within a body in resisting forces acting on it

______z. Film that restricts evaporation of water and acts as a vapor barrier or seal

______aa. Substance used to hold materials together by surface attachment

______bb. Tool with a square steel base to which a long vertical wooden handle is attached; used to compact materials such as dirt, concrete, and dry-pack mortar

______cc. Very dry mortar mix

______dd. Masonry trim designed by corbeling units in intricate patterns, usually at the cornices of buildings

______ee. Center of circle partially circumscribed by inner ring of arch

15. Insulation
16. Puddle
17. Center
18. Reinforcing rods
19. Haunch
20. Slump
21. Perpendicular
22. Adhesive
23. Stress
24. Right angle
25. Membrane
26. Consistency
27. Radius point
28. Gingerbread
29. Tamp
30. Dry pack
31. Vapor barrier

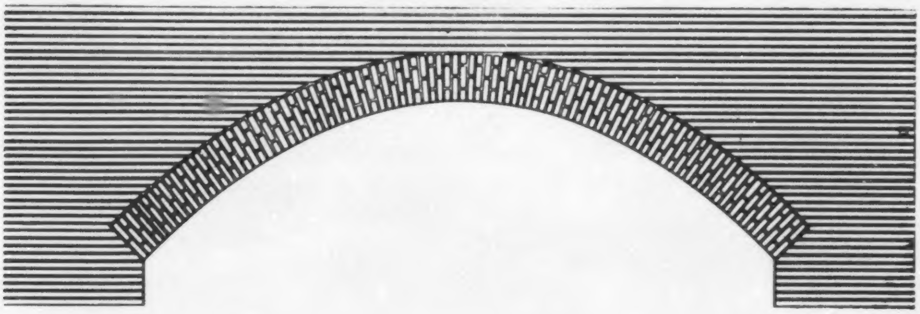
## TEST

2. State two purposes of arches in brick construction.

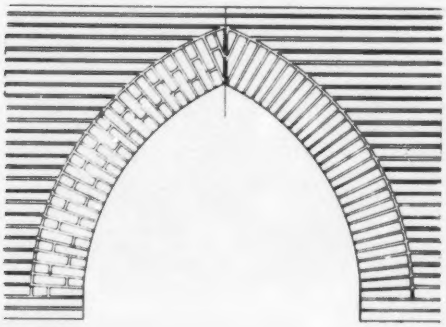
a. ______________________________

b. ______________________________

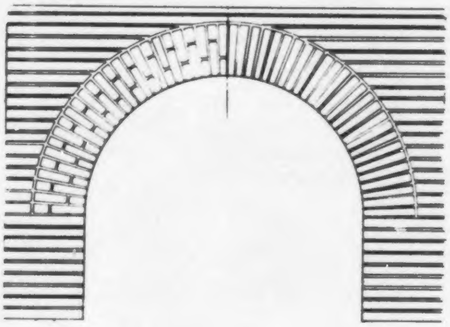
3. Label the following types of arches.



a. ______________________

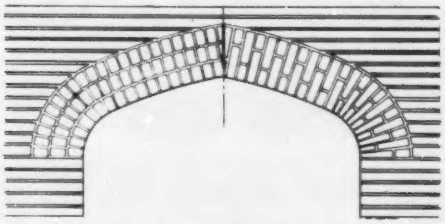


b. ______________________

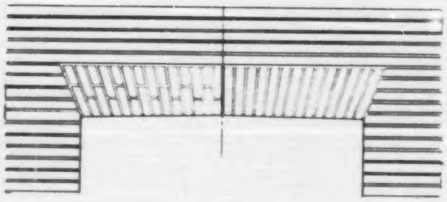


c. ______________________

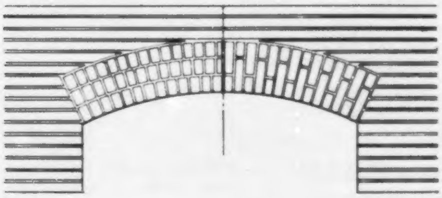
# TEST



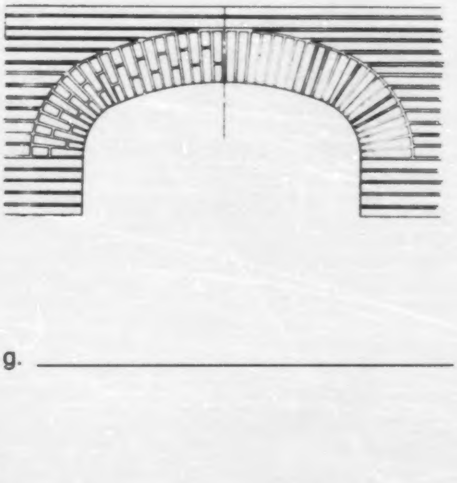
d. ______________________________



e. ______________________________



f. ______________________________



g. ______________________________

## TEST

4. Match arch parts to their correct locations. Write the correct numbers in the blanks.

______a. Units between arch rings and adjacent units in abutment

______b. Sides of abutment or pier that form opening under arch

______c. Highest point of arch; located on center line of symmetrical arches

______d. Bottom curving line or concave curve that extends from one side of arch to other

______e. Unit that wedges arch brick into a secure position; centered in arch ring on center line

______f. Part of the wall above an arch and abutment

______g. Units laid within arch ring

______h. First unit at end of arch; placed against skewback at the spring point

______i. Upper curving line or convex curve that extends from one side of arch to other

______j. Surface or face on inner ring

______k. Part of arch ring between key brick and end of arch ring (right or left side)

______l. Unit between spandrel and arch ring that must be cut to close space between them

______m. Point of pressure between springer and skewback

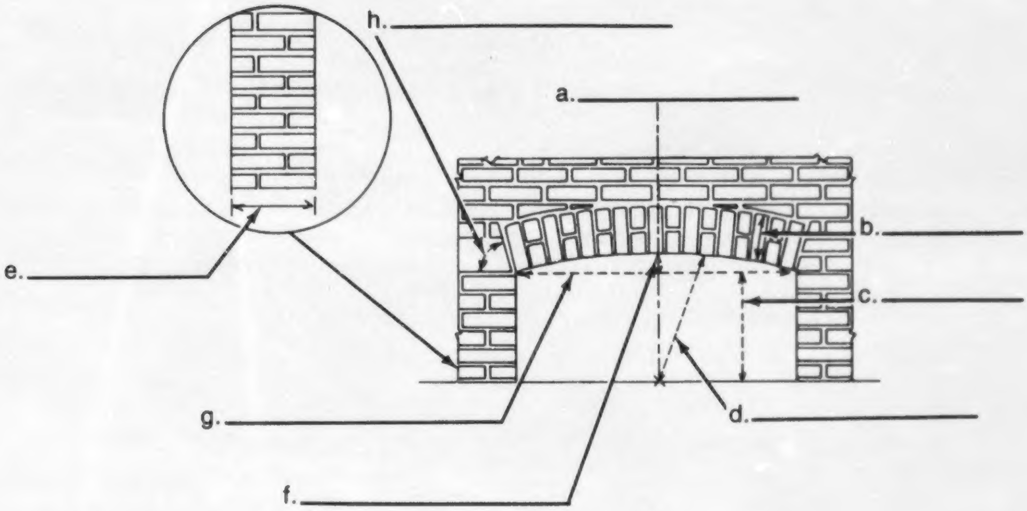
______n. Part of a structure that receives pressure of an arch

______o. Area of an arch between intrados and extrados

1. Intrados or inner ring
2. Spandrel
3. Soffit
4. Arch ring
5. Abutment
6. Extrados or outer ring
7. Keystone or key brick
8. Voussoir or arch brick
9. Skewback
10. Haunch
11. Springer
12. Apex or crown
13. Jamb
14. Spring point
15. Creeper

## TEST

5. Label dimensions of the arch illustrated below.



6. Describe method of finding radius point, given span and rise.

## TEST

7. Arrange in order the procedures for laying out centers for Roman, segmental, elliptical, and Gothic arches. Write a "1" before the first procedure, a "2" before the second procedure, and so on.

______a. Draw arc for intrados ring

______b. Use framing square to draw the rise

______c. Read plans for proper dimensions

______d. Use proper procedure to determine radius point

______e. Extend span line on both ends the depth of arch, and draw arc for extrados ring

______f. Draw span line on a sheet of plywood; use letters to label end points and center

______g. Cut out pattern (template) of each arch brick

______h. Use spacing rule and radius to outline units and spacing

8. State four advantages of masonry paving.

a. ______________________________

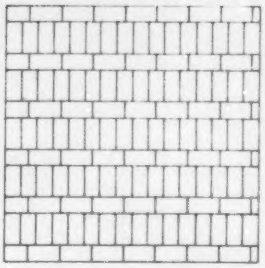
b. ______________________________

c. ______________________________

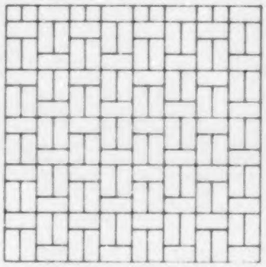
d. ______________________________

9. Identify types of paving patterns. Write the correct names in the blanks.

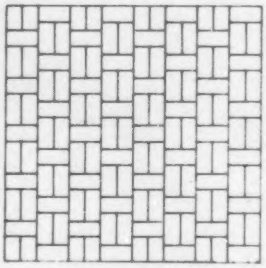
**Variation of basket weave**
**Running and stack bond mixed**
**Circular and running bond mixed**
**One-quarter running bond**
**Stack bond**
**Herringbone**
**Running bond**
**Basket weave**



a. ______________
______________

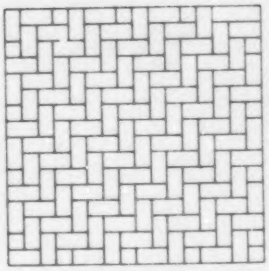


b. ______________
______________



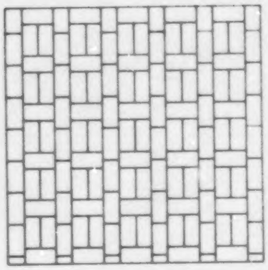
c. ______________
______________

# TEST



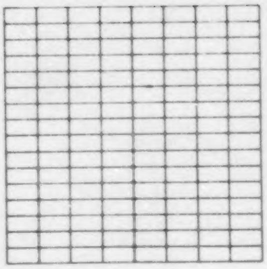
d. ______________________

______________________



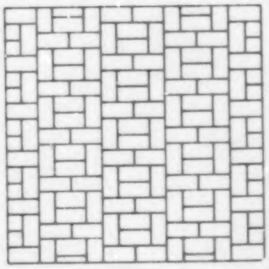
e. ______________________

______________________



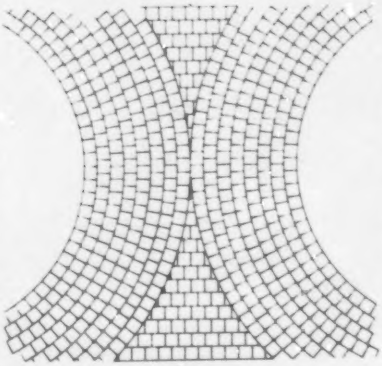
f. ______________________

______________________



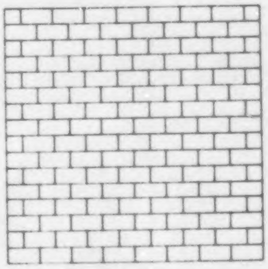
g. ______________________

______________________



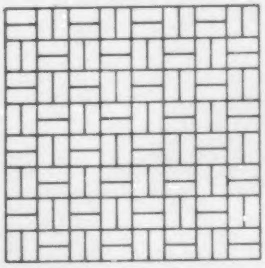
h. ______________________

______________________



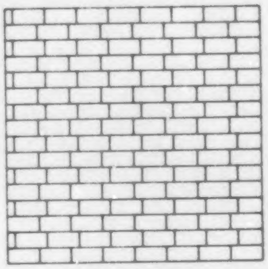
i. ______________________

______________________



j. ______________________

______________________



k. ______________________

______________________

# TEST

10. Select from the following list basic parts of masonry paving. Write an "X" in the blank before each correct answer.

______a. Crown

______b. Wearing surface

______c. Center

______d. Curb

______e. Cushion

______f. Joint

______g. Membrane

______h. Base

11. State five tasks that the bricklayer must be able to perform to install masonry paving.

a. ________________________________________

b. ________________________________________

c. ________________________________________

d. ________________________________________

e. ________________________________________

12. State two reasons for using glazed structural tile.

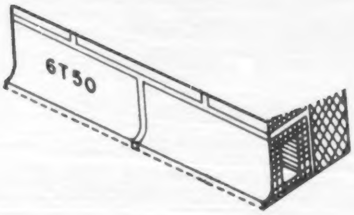
a. ________________________________________

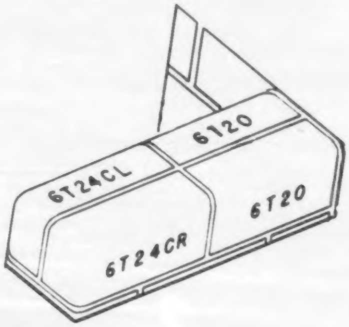
b. ________________________________________

# TEST

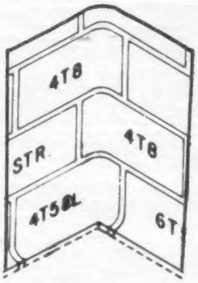
13. Identify types of glazed structural tile. Write the correct names in the blanks.

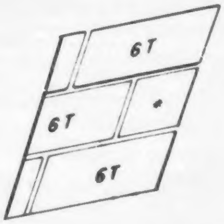
**Stretcher** **Cove corner** **Sill** **Cove base** **Cap** **Bullnose**



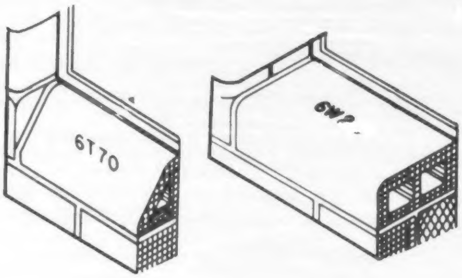

6T20
6T24CL
6T20
6T24CR

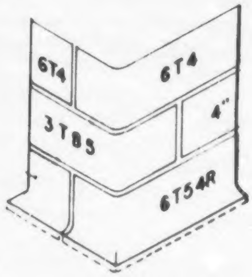
a. ______________________________ b. ______________________________


4T8
STR.
4T8
4T58L
6T



c. ______________________________ d. ______________________________




6T4
6T4
3T83
4"
6T54R

e. ______________________________ f. ______________________________

14. State three purposes of grouting.

a. ______________________________

b. ______________________________

c. ______________________________

## TEST

15. Name types of grout.

    a. ______________________________

    b. ______________________________

    c. ______________________________

16. Name methods of grouting.

    a. ______________________________

    b. ______________________________

17. State four guidelines for building cavity walls.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

18. State two guidelines for building reinforced masonry walls.

    a. ______________________________

    b. ______________________________

19. Match reinforcing-rod sizes to their correct numbers. Write the correct numbers in the blanks.

______a. Rod #10

______b. Rod #7

______c. Rod #2

______d. Rod #5

______e. Rod #9

______f. Rod #8

______g. Rod #4

______h. Rod #3

______i. Rod #6

1. $^{7}/_{8}$-inch diameter
2. $^{3}/_{8}$-inch diameter
3. 1-inch diameter
4. $^{5}/_{8}$-inch diameter
5. $^{3}/_{4}$-inch diameter
6. 1 $^{1}/_{4}$-inch diameter
7. $^{1}/_{2}$-inch diameter
8. 1 $^{1}/_{8}$-inch diameter
9. $^{1}/_{4}$-inch diameter

# TEST

20. Select from the following list purposes of insulation. Write an "X" in the blank before each correct answer.

_____a. Reducing cost of heating and cooling

_____b. Creating heat in the walls

_____c. Reducing year-round comfort

_____d. Conserving energy

_____e. Conserving amount of grout used

_____f. Strengthening walls

_____g. Reducing sound transmission

21. Name five types of insulation used in masonry walls.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

22. State three methods of applying insulation.

a. ______________________________

b. ______________________________

c. ______________________________

23. State two uses of corbeling.

a. ______________________________

______________________________

b. ______________________________

______________________________

# TEST

24. State three guidelines for constructing masonry corbels.

    a. ______________________________

    ______________________________

    ______________________________

    b. ______________________________

    ______________________________

    ______________________________

    c. ______________________________

    ______________________________

    ______________________________

(NOTE: Test questions 25-29 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

25. Lay out center for semicircular arch.

26. Lay out center for segmental arch.

27. Lay out center for elliptical arch.

28. Lay out center for Gothic arch.

29. Demonstrate the ability to install paving brick on a 4-by-6-foot section of sidewalk, using herringbone pattern.

## RELATED LAYOUT AND CONSTRUCTION
## UNIT IV

### ANSWERS TO TEST

1.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | 6 | i. | 2 | q. | 17 | y. | 23 |
| b. | 11 | j. | 5 | r. | 18 | z. | 25 |
| c. | 7 | k. | 8 | s. | 24 | aa. | 22 |
| d. | 1 | l. | 3 | t. | 31 | bb. | 29 |
| e. | 9 | m. | 10 | u. | 19 | cc. | 30 |
| f. | 13 | n. | 12 | v. | 26 | dd. | 28 |
| g. | 4 | o. | 16 | w. | 21 | ee. | 27 |
| h. | 14 | p. | 15 | x. | 20 | | |

2. Answer should include any two of the following
   a. Bridging or spanning an opening
   b. Sustaining weight
   c. Ornamentation

3. a. Parabolic
   b. Gothic or pointed
   c. Roman or semicircular
   d. Tudor
   e. Jack
   f. Segmental
   g. Elliptical or multicentered

4.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a. | 9 | e. | 7 | i. | 6 | m. | 14 |
| b. | 13 | f. | 2 | j. | 3 | n. | 5 |
| c. | 12 | g. | 8 | k. | 10 | o. | 4 |
| d. | 1 | h. | 11 | l. | 15 | | |

## ANSWERS TO TEST

5. a. Center line (℄)
   b. Depth
   c. Elevation
   d. Radius
   e. Thickness
   f. Rise
   g. Span
   h. Skewback angle

6. Description should include the following
   a. Divide span by 2
   b. Multiply answer in A by itself
   c. Divide answer in B by rise
   d. Add answer in C to rise
   e. Divide answer in D by 2 to find radius for arch
   f. Mark radius point by measuring length of radius along center line, beginning at top point of rise

7. a. 5
   b. 3
   c. 1
   d. 4
   e. 6
   f. 2
   g. 8
   h. 7

8. Answer should include any four of the following
   a. Provides durable surface
   b. Adds to appearance
   c. Is economical
   d. Adds color
   e. Can be placed in mortar and jointed with mortar
   f. Can be placed without mortar
   g. May be used for interior or exterior paving
   h. May be used for wide variety of jobs

## ANSWERS TO TEST

9. a. Running and stack bond mixed
   b. Variation of basket weave
   c. Variation of basket weave
   d. Herringbone
   e. Variation of basket weave
   f. Stack bond
   g. Variation of basket weave
   h. Circular and running bond mixed
   i. Running bond
   j. Basket weave
   k. One-quarter running bond

10. b, e, g, h

11. Answer should include any five of the following
   a. Read plans
   b. Follow working drawings to plan work
   c. Lay out section of work to plan total job
   d. Prepare base
   e. Lay cushion that allows proper leveling and support of surface units
   f. Lay surface units to finish grade and slope
   g. Align units in specified pattern bond
   h. Clean, finish, and protect finished product

12. Answer should include any two of the following
   a. Can be easily cleaned
   b. Is stain resistant
   c. Requires low maintenance
   d. Allows color selection

13. a. Cove base
   b. Cap
   c. Cove corner
   d. Stretcher
   e. Sill
   f. Bullnose

## ANSWERS TO TEST

14. Answer should include any three of the following
    - a. Providing strength
    - b. Providing resistance to moisture penetration
    - c. Providing resistance to heat and cold
    - d. Providing resistance to expansion and contraction
    - e. Providing resistance to cracking of mortar joints and units

15. a. Mortar
    - b. Fine grout
    - c. Coarse grout

16. a. Low lift
    - b. High lift

17. Answer should include any four of the following
    - a. Install flashing at base of wall, over openings, and under sills
    - b. Install weep holes every 24 to 32 inches
    - c. Keep cavity clean
    - d. Bevel bed joint mortar
    - e. Use proper ties and proper tie placement
    - f. Use proper mortar
    - g. Use specified insulation, properly installed

18. Answer should include any two of the following
    - a. Install proper reinforcing steel
    - b. Use grout of proper consistency (9- to 12-inch slump)
    - c. Puddle grout to consolidate it
    - d. Use solid, beveled, nonfurrowed bed joints
    - e. Use full head joints

## ANSWERS TO TEST

19.

| | | | | | |
|---|---|---|---|---|---|
| a. | 6 | d. | 4 | g. | 7 |
| b. | 1 | e. | 8 | h. | 2 |
| c. | 9 | f. | 3 | i. | 5 |

20. a, d, g

21. Answer should include any five of the following

    a. Water-repellent vermiculite masonry fill

    b. Silicone-treated perlite loose fill

    c. Molded polystyrene

    d. Expanded polyurethane

    e. Rigid urethane

    f. Cellular glass

    g. Preformed fiberglass

    h. Perlite board

22. Answer should include any three of the following

    a. Pouring granular insulation into cores and cavities

    b. Inserting polystyrene into block cores

    c. Applying rigid insulation with adhesive

    d. Applying rigid insulation with adjustable wall ties

23. Answer should include any two of the following

    a. Thickening a wall to suit a particular job condition or requirement

    b. Forming a ledge to hold items such as flue liners or mantels on fireplaces

    c. Decorating structure

# ANSWERS TO TEST

24. Answer should include any three of the following
    a. Do not overlap or extend bricks of each projecting course by more than one-half brick width or one-third bed height
    b. Use good bonding practices
    c. Use headers extensively
    d. Use only bricks that are dry and free of chips or cracks
    e. Avoid working too fast
25. Evaluated to the satisfaction of the instructor
26. Evaluated to the satisfaction of the instructor
27. Evaluated to the satisfaction of the instructor
28. Evaluated to the satisfaction of the instructor
29. Performance skills evaluated to the satisfaction of the instructor